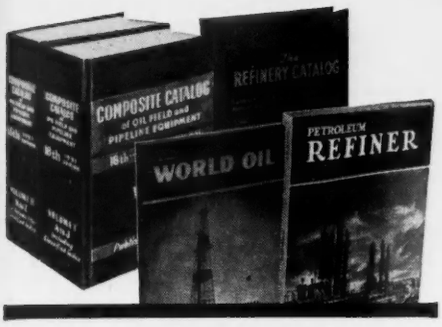


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**WORLD OIL and The COMPOSITE CATALOG**
**for the drilling-producing-pipe line industry**

**PETROLEUM REFINER and The REFINERY CATALOG**
**for the refining-natural gasoline industry**

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# WORLD OIL

Established 1916 as THE OIL WEEKLY

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# Looking Ahead

DEMAND FOR PETROLEUM products could fall short of some expectations, as slowing down of general business activity is indicated. National Association of Purchasing Agents sees possibility of a moderate business recession in remainder of 1951, perhaps comparable with letdown in 1949. High inventories, from manufacturer to retailer, are reported, as demand fails to absorb supplies, thus forcing declines in prices of many goods. Lagging sales are due to advance buying of the past, credit controls, higher taxes, unemployment caused by cutbacks in civilian production for conversion to military output, and decline of scare buying.

UNDER PRESENT DEFENSE PROGRAM plans, no early end of controls on prices, credit, and materials and accompanying red tape is in prospect. Washington planners conditionally promise end of controls and full restoration of economic freedom in late 1955, 4½ years from now, with loosening of restrictions to begin in 1953 – all of this barring allout war.

PLANNERS DEPEND ON EXPANSION of industrial facilities and production and on employment of more workers to achieve hopes of providing large military supplies and expanding armed forces while also meeting large civilian demand to above indicated extent of partially lifting controls in 1953 and wholly in late 1955. Defense and State departments feel that rearmament should not be so rapid as to cut too deeply into civilian production, disrupt the economy, and overburden taxpayers; that slower though determined military buildup will be sufficient for presently indicated defense requirements.

PAD'S COMPREHENSIVE STUDY of transportation facilities and needs is due to be completed around June 15. It will show what kinds of facilities are most urgently needed and help to get maximum transportation from every ton of steel used.

DELIVERIES OF NATURAL GAS to industrial consumers in some localities may have to be severely curtailed next winter. With steel available for this purpose limited, line pipe orders accepted by mills for delivery in 1951 have been slowed three to 12 months. Oil and gas pipe line construction for meeting growing fuel needs consequently is similarly delayed, and some important projects will not be completed this year as scheduled. Through expansion under way, gas companies this year are expected to increase fuel deliveries to Chicago, Detroit, San Francisco, and other areas, while New England will be among new regions to receive natural gas.

STRAIN ON TRANSPORTATION AND STORAGE facilities for oil also is indicated for next winter, due to steel scarcity, especially if weather is severe, and scarcity of gas would cause greater oil use and more difficulty in meeting oil demand. While construction of oil pipe lines is retarded, tank car construction program is slow getting under way and tank truck supply may be inadequate. Oil industry needs 80 million barrels of new storage facilities in 1951 but will be able to build only half that amount, compared with 58 million built in 1950, unless it gets more steel than expected.

SHORTAGE OF RAILROAD FREIGHT CARS may add to difficulties of getting steel goods and other materials in latter half of 1951, especially during fall peak of rail traffic. Several steel, cement, lumber, and milling companies say railroads even now are barely able to handle their shipments, and situation will get worse when grain harvest starts.

# Don't get caught with your circulation down!

## JELFLAKE... the standard of the oil fields... is your best insurance against mud losses

Many experienced drilling operators find that conditioning mud with Jelflake is good insurance against mud losses. This tough, thin, fragmented plastic foil filters out on formation walls—seals off "thief" formations.

Jelflake is first choice for preventing or regaining lost circulation in many fields. It is quickly and easily used, holds its strength, will not ferment. Jelflake's crinkled surface prevents it from balling, and its low specific gravity allows it to remain in suspension in drilling mud for an indefinite time. Jelflake pumps easily through pump valves and circulating equipment, and its properties are not adversely affected by water, oil, mud chemicals, bacterial action or high bottom hole temperatures and pressures.

Jelflake is also used to prevent loss of cement slurry during cementing operations. Ask your nearest mud distributor, supply store or Dowell station for Jelflake, packaged in strong, wet-proof 25-pound bags.

**DOWELL INCORPORATED**
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

*Keep* ***Jelflake*** *Handy!*

Look to DOWELL

FOR OIL INDUSTRY CHEMICAL SERVICE

Ask your nearest Dowell Station for complete information on these Dowell services and products: Acidizing, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents and Bulk Inhibited Hydrochloric Acid.

*"Petroleum Promotes Progress"*

Editor's Page

# WILL HISTORY REPEAT?

IT WAS AN UNHAPPY DAY for the U. S. when public servants began to place individual and party ambitions ahead of the welfare of the country and its people. After all is said and done, the chief reason so much difficulty is being experienced in meeting the serious problems which confront the nation at this moment is the almost complete adherence of politicians to party rather than to their country. This attitude also is responsible for much of the confusion, waste of manpower and money in government, and even for the corruption which flourishes in Washington and the nation. Such conditions set a sinister question mark on the continuity and security of democracy in the U. S.

There are examples of communists, like Alger Hiss, being permitted to occupy important government jobs even though under suspicion. Even now, after the sad experiences of the past, others under suspicion of working for other nations continue to retain their government positions. There are the recent exposures of payoffs on procurements of RFC loans, and of gambler syndicate tie-ins with politicians, etc. Waste is tolerated, as politicians emphasize buying of favor with this group and that group of voters. Price levels of certain commodities are maintained by government subsidies and government buying of surpluses to procure political favor with voting groups. The government of this country now spends more money in five years than was spent in the first century and a half of its existence.

All these conditions are largely the result of politicians placing the welfare of themselves and their political party ahead of national welfare. In almost every instance in which there is a choice between country and party, the party, right or wrong, is sustained by entirely too many government office holders. National leadership has been supplanted by party leadership.

THESE CONDITIONS have a striking parallel with many earlier great governments of the world. What happened to Egypt, Persia, Rome, the French Empire and other great nations of the past? History shows that power gradually resolved itself into fewer and fewer hands. The Roman Senate, once known for its dignity and independence, began to obey the desires and wishes of the current demagogue. Corruption, confusion and reckless expenditure of tax revenues increased in all these early day great nations under such conditions, until they sank into complete decay as political and individual welfare replaced national welfare.

• • •

IF THE U. S. IS NOT to go down this same path of historical, moral and material degeneration, its citizens had better do some thinking — and soon, before it is too late to check the tendency now so much in evidence. This is something all good Americans should be thinking about. Present conditions bear entirely too much resemblance to the historical lessons taught by earlier great powers of the world.

Sorely needed is the teaching of American doctrines and national patriotism to our young—the future citizens of this country. Not enough emphasis is placed on this subject in our schools today. We are letting our young grow up without understanding the fundamental factors which made this nation the most progressive in the world.

Warren L. Baker

# DO YOU KNOW HOW "Metal Petals" BRING YOU SUCCESSFUL CEMENTING RESULTS?

In any cementing where a lower zone must be protected from contamination by the cement slurry (as well as from sloughings or cavings) the Baker METAL PETAL Basket will be found both safe and successful.

The unit is constructed of a number of individual "petals" made of flexible sheet metal. These petals are mounted on reinforcing spring steel ribs, which in turn are mounted on a ring to form the Basket.

When running in the hole, the upward pressure of the fluid tends to close the "petals" thus providing fluid passageway between the Basket and the walls of the hole, without distortion of the Basket. As soon as the casing comes to rest, upward pressure by the fluid is relieved and the petals expand to contact the walls of the hole. Any tendency of fluid to move downward then presses the flexible petals more firmly against the entire circumference of the hole. Solids strained from the fluid tend to build a bridge inside the Basket which is thus converted into a one-way packer of great strength and effectiveness.

## SIMPLE, EFFECTIVE ACTION

The "Metal Petals" not only expand to contact the entire circumference of large diameter holes, but also pack-off in holes of irregular shape; and the independent action of the individually mounted overlapping petals permits successful use of the Basket in casing programs with minimum clearances.

All-metal construction and design provide ample strength; lessen the possibility of splitting or otherwise damaging the Basket while it is being run in; and the metals are unaffected by usual acids employed for various purposes.

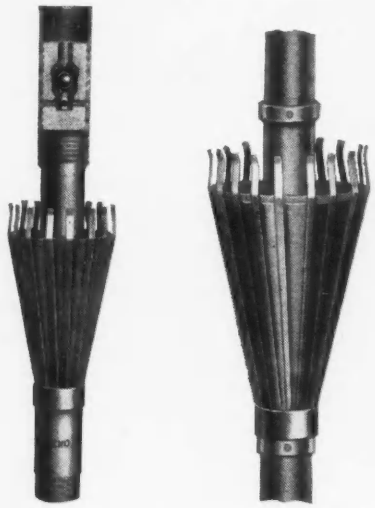
## MOUNTINGS TO MEET ALL NEEDS

Baker Metal Petal Baskets are furnished mounted on plain or perforated nipples; with or without different types of Baker Whirler Float Collars; for a wide range of cementing applications. When conditions permit, it is recommended that Baker Metal Petal Baskets be "slidably" mounted to allow rotation, spudding, or reciprocation of the casing without distorting or damaging the Basket. Maximum efficiency of Baskets is assured when a Baker Model "G" Casing Centralizer is used immediately below the Basket assembly. For details see the Baker (or Composite) Catalog; or ask any Baker representative for specific recommendations.

**TOP, Baker Metal Petal Basket (Product No. 340) ready for assembly into any required cementing hook-up. The strong, spring steel ribs, each with a "metal petal" attached, expand against the wall of the hole to form a safe "one-way" packer which prevents downward movement of the cement slurry.**

**LOWER VIEW illustrates the overlapping "petals" (each mounted on its individual spring steel rib) thus providing flexibility and freedom of expansion to pack-off around the circumference of large-diameter holes, or holes of irregular contours. A Baker Model "G" Casing Centralizer mounted just below the Basket is recommended.**

**LEFT, a popular hook-up consisting of a Baker Metal Petal Basket mounted on nipple, with a Baker Cement Whirler Float Collar with Solid Baffle (Product No. 305) which causes the cement slurry to pass through the baffled, side-whirler ports.**



**RIGHT. Where the casing is to be rotated or reciprocated while cementing, the Metal Petal Basket is "slidably" mounted between two Stop Rings. This permits free rotation, and ample vertical movement of the casing, without distorting or damaging the Basket.**

## HERE'S AN EXAMPLE OF STRENGTH

The Baker Metal Petal Basket holds a record for keeping cement ABOVE and OUT OF a "zone" possessing *lower formation pressure* and *higher permeability* than is likely to be encountered in any oil well. The "zone" was an *open* coal mine stope (lateral) through which a 16-inch hole had been drilled. A Baker Metal Petal Basket, mounted on 10¾" casing (used as the surface string) successfully supported a 640-foot column of cement slurry above the stope, without breakdown or leakage. This example not only demonstrates the bridging ability of the Basket assembly, but also is evidence of the tremendous structural strength which it possesses.

**BAKER**
**METAL PETAL BASKET**
**PRODUCT NO. 340**

**BAKER OIL TOOLS, INC.**
HOUSTON • LOS ANGELES • NEW YORK

# The Changing Panorama

## One Producer for Nine Wildcats Is True Ratio

THE RISKS and losses of capital in wildcatting and finding oil are much greater than generally realized, points out Dr. Frederic H. Lahee, authority on statistics of wildcatting. He cautions that while one out of five "exploratory" wells is a producer, this ratio includes tests in or adjacent to established fields, seeking to tap new productive zones or materially extend limits of those already known. There is only one producer out of nine wells, he said, in "rank" wildcat drilling on a structure or in a geologic environment never before productive. This is the average risk, he added, in true wildcatting.

Furthermore, said Lahee, dry-hole ratios do not tell the whole story. A wildcat which proves productive does not mean that the well is a commercial success. "Some wildcats do not produce enough to pay for the drilling. If we consider factors such as the averages for depth of new field—"rank"—wildcat drilling (over 4200 feet for 1944 to 1949 inclusive), number of field development wells required to drill up a field, number of dry holes drilled to outline the dimensions of the field, it is assumed that a field having a total ultimate recovery of 1 million barrels is, on the average, close to the economic limit. Some such small fields may pay moderate profits; others may result in net financial losses."

An analysis by Dr. Lahee of exploratory drilling data for the years 1944-1946 inclusive reveals only one in 44 new field (rank) wildcats discovered a field with more than 1 million barrels of total ultimate recoverable reserves.

Dr. Lahee's data on dry-hole ratios in rank wildcatting can be supported and amplified by a WORLD OIL tabulation (February 15, 1951, issue, page 76). That table shows that during the past 14 years, 58,051 rank wildcats were drilled, of which 6703 wells or 11.5 percent were productive, a ratio of about one out of nine. The ratio has varied from year to year, ranging from 9.4 percent productive (one out of 11) in 1939 to 13.0 percent productive (one out of eight) in 1950.

Emphasizing the uncertainty of "hitting" oil or gas on a wildcat site is the fact that dry-hole ratios vary widely by states and districts and by years. On a long-term basis, chances of success have been better than average in various districts, including New Mexico and the Texas Gulf Coast (1 out of 8 wildcats productive), North Texas (1 out of 7), Kansas, Oklahoma, Montana, West Texas (1 out of 6), and Wyoming (1 out of 5). On the other hand, the chance of success has been less than the national average of 1 producer out of 9 wildcats for areas that include Indiana and Kentucky (1 out of 10), Arkansas, North Louisiana, Texas Panhandle (1 out of 12), Michigan, Colorado, Northeast Texas (1 out of 14), Illinois (1 out of 16), and California (1 out of 20). Although Alabama and Mississippi each yielded 1 producer for every 11 wildcats drilled in 1950, earlier wildcatting was discouraging, for in the past 14 years Alabama yielded only 5 producers out of 188 wildcats (1 out of 37) and Mississippi 52 productive out of 1087 wildcats (1 out of 21). Florida in 14 years has netted one oil field out of 140 wildcats.

## Shale Deposits Given Increased Attention

SHALE DEPOSITS will be of particular significance to the Pacific Coast area if and when that area requires supplemental sources of petroleum and whenever the economic balance decides when shale oil will fit into the picture. Reasoning behind this belief, according to Howard G. Vesper, president of California Research Corporation, San Francisco, subsidiary of Standard Oil Company of California, is the fact that oil shale, which at present is the most attractive of the synthetic alternates, is located in large quantities on the western slope of the Rocky Mountains.

Under normal conditions, Vesper estimates, it would be perhaps another ten years before the West Coast might require such supplemental sources of petroleum. He believes it is entirely possible, however, that the military considerations involved in increasing the liquid energy supplies within the U. S. will accelerate the shale development into an active plant during the next several years.

## Tax Ax May Snatch Many Autos off Road

THE PETROLEUM INDUSTRY has been alerted to the danger that excessive automotive and gasoline taxes could price many Americans out of the use of motor cars and thereby out of the market for petroleum products. High taxes have been largely instrumental in making automobiles a luxury in European countries and threaten to do so in the U. S., warns an article in the *Tax Economics Bulletin* of the American Petroleum Industries Committee.

Americans own more than 75 percent of the world's automobiles, or one car for every four people. In Great Britain the proportion is 1 car for every 22 people; in France, 1 for every 27; and in Italy, only 1 for every 176.

While crediting mass production, abundance of raw materials, and high average incomes as factors in wide ownership of automobiles in America, the article said much of Europe's failure to keep pace "can be traced directly to excessive taxation."

In Great Britain, the purchase tax on a medium-priced car is equal to one-third the retail value, and Britons must also pay registration fees three times that of the average American levy. Gasoline taxes are staggering in Europe. In Great Britain, taxes add about 75 percent to the retail price of gasoline. In France, they add well over 100 percent, and in Italy more than 200 percent.

In the U. S., automotive taxes, though less burdensome, have been gradually increasing and threaten to continue rising. Taxes in this country now take 24 cents out of every automotive dollar. In the U. S., gasoline taxes add 33⅓ percent to the retail price of gasoline.

If carried to excess, automotive taxation will defeat its purpose of raising revenue, by preventing automobile use, at the same time causing hardship for Americans, declared the *Bulletin*. Excessive taxation is a serious threat to mass car ownership, it added, as evidenced by a Federal Reserve Board survey showing that 74 percent of all automobiles in the U. S. are owned by families with incomes below $5000 per year.

*Report from the Observatory*

# Oil Stocks May Become Excessive

RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

THERE IS A NEED for the industry to guard against the danger of over-optimism in the months ahead. With passage of winter, a normal seasonal decrease in demand can be expected during the next six months. This situation, coupled with recent additions to stocks and prospects of further inventory accumulations during May, indicates smaller producing and refining rates will become desirable in the very near future.

Record supply in recent months has overhauled demand. Consequently, the industry's supply-demand position has been reversed. A trend toward inventory accumulation became apparent in March and April, and in contrast with earlier conditions most refined product stocks now are higher than a year ago. With May producing rates again fixed at peak levels, additional substantial growth in stocks will take place. If refiners reduce runs to stills during May, the industry will be in a good position at that time. Stocks will be adequate, but not burdensome. However, further maintenance of current peak crude and products output during the remainder of 1951 would result in additions to stocks beyond needs or desirable limits. After May, requirement needs will have to be watched more carefully, and producing and refining rates should be speedily adjusted to demand volumes so as to avoid the possibility of creating excessive stocks.

• • •

THE QUICK TRANSITION of the industry's position is illustrated by recent stock changes. Whereas distillate fuel oil inventories at the end of February were 4 million barrels below 1950 volumes, they were 6 million barrels greater than year-ago levels by midApril. Residual fuel oil inventories, which had been 9 million barrels less than in 1950 at the end of February, were only 4 million barrels beneath year ago volumes by midApril. Meanwhile, stocks of gasoline continued to stay above last year, and on April 21 were 7½ million barrels greater than in 1950. These changes in the industry's product stock position are the result of a greater gain in production than in demand.

On the other hand, crude oil stocks were down to 237 million barrels, about 4 million barrels less than at the corresponding period of 1950.

• • •

SOME ADDITIONS TO STOCKS are desirable in view of higher demand, especially in distillate fuels preparatory to winter heating oil consumption. Larger crude oil stocks also would be desirable. However, excessive additions to inventories could take place suddenly if the industry maintains present producing and refining rates after May.

The relative position of crude and refined product inventories points to the need for refiners to reduce runs to stills in May. This would have the desirable effect of permitting a buildup of crude stocks, and holding down the accumulations of refined product inventories. In view of larger demand, it appears desirable that crude oil inventories be increased to approximately 250 million barrels, 13 million more than in midApril.

The next seasonal shift in petroleum consumption will occur November 1, when another heating oil season opens. In the interim, the industry needs to enlarge its stocks of distillate and residual fuel oils while reducing inventories of gasoline. In view of increased demand, the industry should find it beneficial to have approximately 90 million barrels of distillate fuel oil on hand November 1. This would be 5 million barrels more than on November 1 last year, but since these stocks at present already are 6 million above a year ago the rate of increase needs only to equal that of 1950. Residual fuel oil stocks should be raised to approximately 50 million barrels by next November, or 5 million more than at that time in 1950. Since present levels are only 4 million less than a year ago, the rate of making additions needs to be but slightly above last year's volumes. On the other hand, gasoline stocks should be reduced to around 110 million barrels by November 1 in contrast with the midApril level of 139 million barrels. Proper adjustment of refinery product yields during coming months will be an important factor in determining how well the industry balances individual product inventories with November 1 needs.

• • •

CAUSE OF THE SUDDEN CHANGE in the industry's supply-demand relationship is the slump in demand. This is a normal seasonal trend and does not indicate any unusual change in the consuming picture.

It must be borne in mind that winter demand always is the highest level of the year because of the additional consumption created by heating oil. Requirements during the second quarter are likely to be more than ½ million barrels per day less than in the first three months of the year due to the usual seasonal decrease at this time of the year. There should be some increase in demand during the third quarter of the year, but not enough to reach the first quarter peak. Hence, continuation of current record producing and refining rates would surely cause substantial inventory growth during the second and third quarters of the year.

These conditions indicate stock trends in May should be watched carefully, and caution be exercised in producing and refining rates thereafter.

# NEW CRANE CLASS 600 PIPE LINE GATE VALVES GIVE YOU MANY ADVANTAGES

***EASIER OPERATION***

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***SMOOTH, CLEAR FLOW***

***COMPLETE GREASE SEALING***

***PROTECTED SEATS***

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**STREAMLINE FLOW**—Disc ports align with seat openings to provide smooth passageway when valve is fully open. No turbulence. Least possible resistance to flow. No pockets to accumulate dirt.

**LUBRICATED WORKING PARTS.** Body packed with grease to reduce friction and wear of internal parts. Grease provides seal at seats, bonnet joint, and stem, which helps maintain pressure tightness.

**DUAL-SEATING DOUBLE DISC** wedges tight both in fully open and closed positions. Seals off grease from line fluid; protects disc seating surfaces when valve is open.

**ACCURATE DISC GUIDING** assures correct seating and prevents cramping or binding the stem.

**PRESSURE-TIGHT BOLTED BODY-BONNET JOINT.** Line pressure forces synthetic rubber "O" ring gasket into wedge-shaped groove in body flange and helps keep the joint tight.

**GET THIS NEW CIRCULAR**

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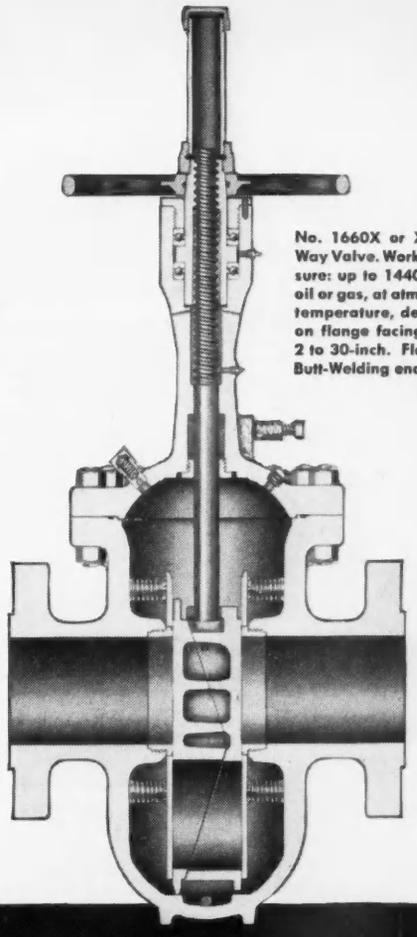
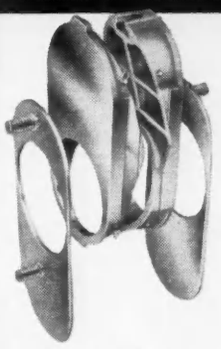


No. 1660X or XH, Full-Way Valve. Working Pressure: up to 1440 pounds oil or gas, at atmospheric temperature, depending on flange facing. Sizes: 2 to 30-inch. Flanged or Butt-Welding ends.

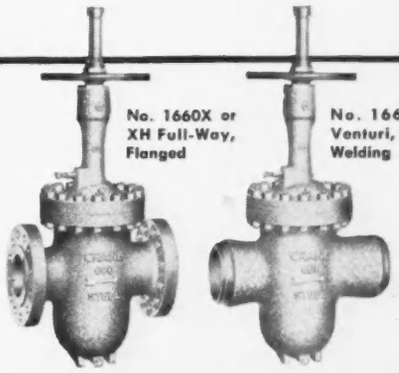
## HOW THEY OPERATE



**Double disc wedges tightly against shoulder type body seat rings in both open and closed positions. This protects seat faces from erosion and wear.**

**Movable spring-loaded plates, shown here, retain grease in body and bonnet while valve is being operated . . . also close "conduit" openings in disc against entrance of grease when valve is partly or fully closed.**

**Only one half of disc is attached to valve stem. At both ends of its travel, the unattached half of the disc comes in contact with stops. Additional wheel rotation then moves the stem-attached half of the disc farther, forcing both discs outward against seat rings and wedging them there.**



No. 1660X or XH Full-Way, Flanged

No. 1665XH Venturi, Butt-Welding

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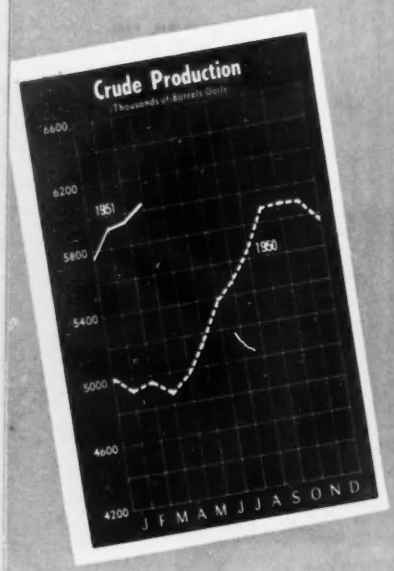
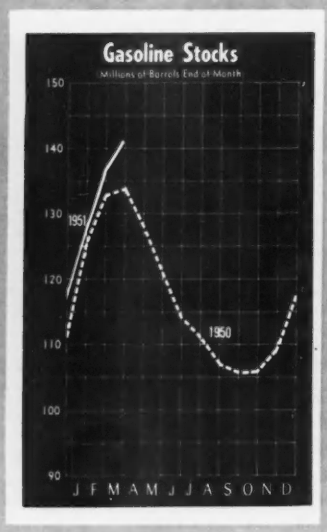
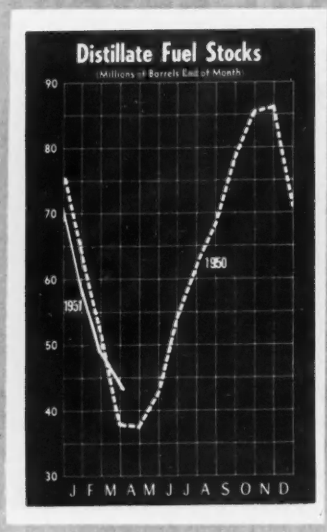
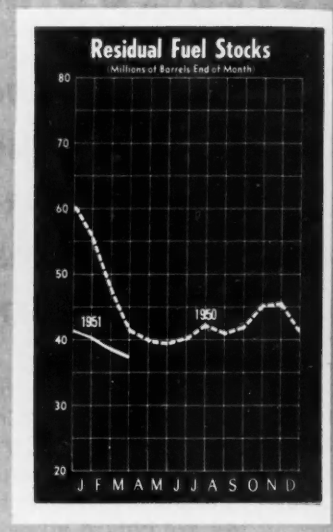
# Petroleum

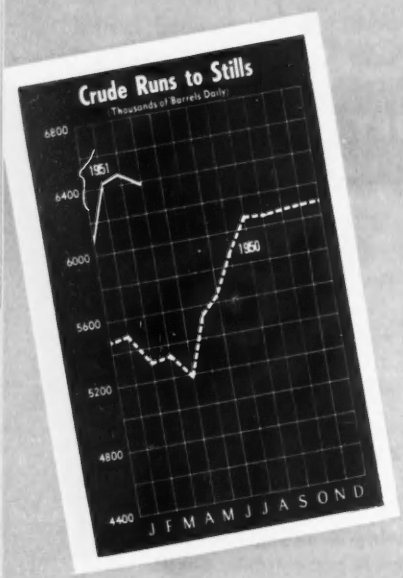
By CECIL W. SMITH,



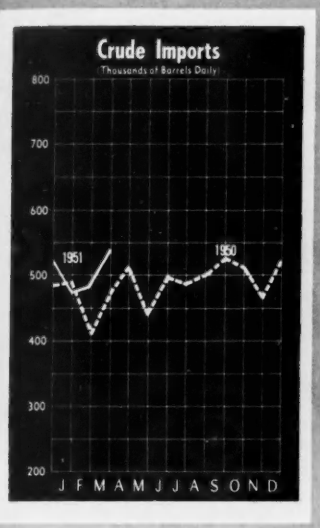
## U. S. Crude Production by States

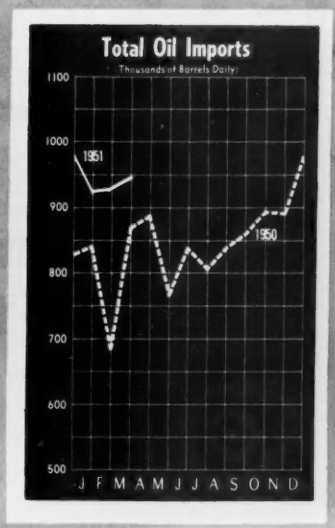
(THOUSANDS OF BARRELS)

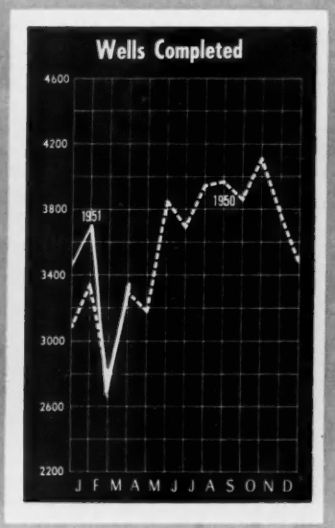
| STATE or DISTRICT | DAILY AVERAGE PRODUCTION | | | | TOTAL PRODUCTION First Three Months | | |
|---|---|---|---|---|---|---|---|
| | March, 1951 | February, 1951 | March, 1950 | % Diff. March, '50-'51 | 1951 | 1950 | % Diff. '50-'51 |
| Alabama | 2.9 | 2.4 | 1.5 | + 93.3 | 242 | 131 | + 84.7 |
| Arkansas | 82.3 | 82.4 | 85.4 | — 3.6 | 7,379 | 7,730 | — 4.6 |
| California | 967.0 | 960.7 | 857.5 | + 12.8 | 86,605 | 77,664 | + 11.5 |
| Colorado | 79.4 | 77.0 | 59.7 | + 33.0 | 6,928 | 5,434 | + 27.5 |
| Florida | 1.6 | 1.6 | 1.0 | + 60.0 | 141 | 91 | + 54.9 |
| Illinois | 165.4 | 161.2 | 176.3 | — 6.2 | 14,807 | 15,412 | — 3.9 |
| Indiana | 27.0 | 27.4 | 27.4 | — 1.5 | 2,410 | 2,308 | + 4.4 |
| Kansas | 316.5 | 293.5 | 290.4 | + 9.0 | 27,390 | 25,217 | + 8.6 |
| Kentucky | 28.3 | 28.0 | 27.1 | + 4.4 | 2,571 | 2,176 | + 18.2 |
| Louisiana | 642.8 | 634.7 | 534.8 | + 20.2 | 57,193 | 49,827 | + 14.8 |
| North Louisiana | 129.2 | 129.3 | 126.3 | + 2.3 | 11,291 | 11,200 | + 0.8 |
| South Louisiana | 513.6 | 505.4 | 408.5 | + 25.7 | 45,902 | 38,627 | + 18.8 |
| Michigan | 39.1 | 40.1 | 45.0 | — 13.1 | 3,578 | 4,031 | — 11.2 |
| Mississippi | 104.3 | 104.5 | 100.6 | + 3.7 | 9,395 | 8,901 | + 5.5 |
| Missouri | 0.1 | 0.1 | 0.1 | ..... | 8 | 7 | + 14.3 |
| Montana | 24.5 | 24.8 | 22.2 | + 10.4 | 2,196 | 1,923 | + 14.2 |
| Nebraska | 10.2 | 9.9 | 2.1 | +385.7 | 882 | 174 | +406.9 |
| New Mexico | 139.2 | 135.0 | 125.7 | + 10.7 | 12,318 | 11,596 | + 6.2 |
| New York | 13.9 | 13.7 | 11.7 | + 18.8 | 1,176 | 1,032 | + 14.0 |
| Ohio | 9.0 | 7.0 | 9.4 | — 4.3 | 747 | 824 | — 9.4 |
| Oklahoma | 500.7 | 497.2 | 400.2 | + 25.1 | 44,793 | 36,228 | + 23.6 |
| Pennsylvania | 28.9 | 29.3 | 31.3 | — 7.7 | 2,734 | 2,771 | — 1.3 |
| Tennessee | 0.1 | 0.1 | 0.1 | ..... | 3 | 7 | — 57.2 |
| Texas | 2,654.4 | 2,603.4 | 1,893.9 | + 40.2 | 234,880 | 174,279 | + 34.8 |
| Dist. 1—South Central | 33.0 | 32.0 | 26.0 | + 26.9 | 2,925 | 2,337 | + 25.2 |
| Dist. 2—Middle Gulf | 160.1 | 155.4 | 115.5 | + 38.6 | 14,116 | 10,306 | + 37.0 |
| Dist. 3—Upper Gulf | 484.9 | 478.0 | 333.7 | + 45.3 | 43,003 | 32,616 | + 31.8 |
| Dist. 4—Lower Gulf-S.W. | 247.3 | 243.3 | 184.1 | + 34.3 | 21,905 | 16,399 | + 33.6 |
| Dist. 5—East Central | 48.8 | 47.0 | 23.8 | +105.0 | 4,260 | 2,640 | + 61.4 |
| Dist. 6—Northeast | 381.0 | 380.0 | 329.3 | + 15.7 | 34,147 | 28,183 | + 21.2 |
| Dist. 7-B—North Central | 79.2 | 77.7 | 62.4 | + 26.9 | 7,034 | 5,605 | + 25.5 |
| Dist. 7-C—West Central | 91.9 | 86.5 | 49.8 | + 84.5 | 7,926 | 4,393 | + 80.4 |
| Dist. 8—West | 891 6 | 866.3 | 536.7 | + 66.1 | 78,113 | 50,632 | + 54.3 |
| Dist. 9—North | 147.5 | 147.3 | 130.0 | + 13.5 | 13,572 | 12,090 | + 12.3 |
| Dist. 10—Panhandle | 89.1 | 89.9 | 89.2 | — 0.1 | 8,069 | 8,129 | — 0.7 |
| Utah | 3.6 | 3.6 | 3.0 | + 20.0 | 317 | 268 | + 18.3 |
| Virginia | 0.1 | 0.1 | 0.1 | ..... | 7 | 6 | + 16.7 |
| West Virginia | 7.3 | 7.3 | 7.9 | — 7.6 | 669 | 706 | — 5.3 |
| Wyoming | 191.3 | 186.8 | 163.4 | + 17.1 | 17,063 | 14,125 | + 20.8 |
| Total United States | 6,039.9 | 5,931.8 | 4,877.8 | + 23.8 | 536,432 | 442,876 | + 21.1 |

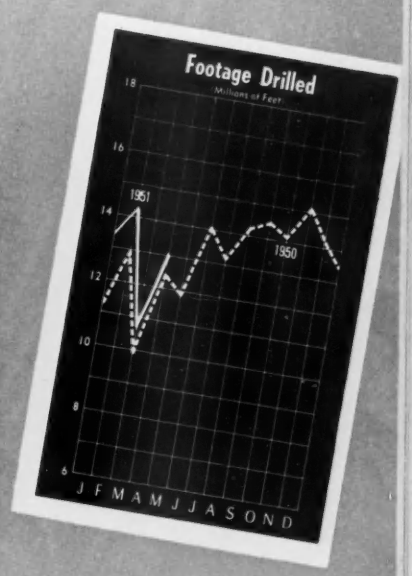
# Trends in U. S.

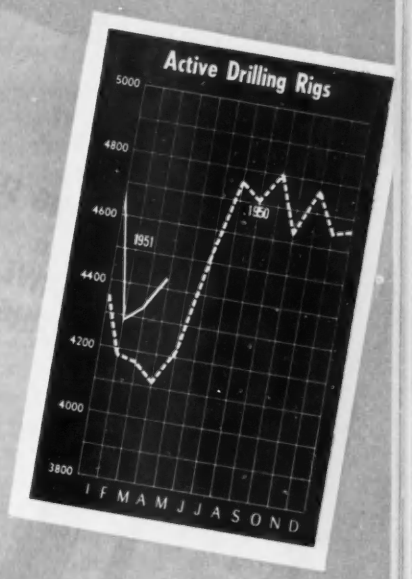
WORLD OIL Staff



## Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

| MONTH | CRUDE OIL | | | GASOLINE | | DISTILLATE FUEL | | RESIDUAL FUEL | | DAILY IMPORTS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production Daily | Runs to Stills Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Production Daily | Stocks End of Month | Crude Oil | Total Oils |
| **1949:** | | | | | | | | | | | |
| March | 5,224 | 5,352 | 269,341 | 2,470 | 127,443 | 993 | 48,928 | 1,258 | 58,190 | 358 | 522 |
| April | 5,012 | 5,141 | 272,520 | 2,494 | 125,351 | 846 | 51,231 | 1,147 | 59,668 | 398 | 593 |
| May | 4,972 | 5,195 | 273,912 | 2,585 | 121,602 | 813 | 57,442 | 1,138 | 63,576 | 409 | 572 |
| June | 4,903 | 5,162 | 274,691 | 2,597 | 114,041 | 771 | 64,730 | 1,041 | 64,628 | 400 | 598 |
| July | 4,704 | 5,173 | 267,586 | 2,613 | 111,217 | 835 | 71,553 | 1,040 | 66,084 | 428 | 624 |
| August | 4,780 | 5,241 | 260,585 | 2,593 | 104,879 | 902 | 76,037 | 1,078 | 66,843 | 413 | 614 |
| September | 4,940 | 5,427 | 251,689 | 2,617 | 101,799 | 1,002 | 83,213 | 1,110 | 67,117 | 374 | 623 |
| October | 4,997 | 5,373 | 250,932 | 2,643 | 103,287 | 1,001 | 90,643 | 1,141 | 68,673 | 492 | 785 |
| November | 5,210 | 5,293 | 256,010 | 2,594 | 104,707 | 962 | 88,212 | 1,180 | 65,112 | 435 | 703 |
| December | 5,024 | 5,475 | 253,356 | 2,633 | 111,521 | 1,032 | 75,207 | 1,203 | 60,193 | 485 | 828 |
| **1950:** | | | | | | | | | | | |
| January | 4,922 | 5,483 | 246,610 | 2,575 | 125,298 | 1,048 | 63,932 | 1,209 | 55,808 | 487 | 841 |
| February | 4,967 | 5,316 | 243,750 | 2,552 | 132,796 | 1,026 | 52,206 | 1,172 | 47,828 | 411 | 684 |
| March | 4,878 | 5,336 | 241,230 | 2,539 | 133,766 | 938 | 37,777 | 1,154 | 41,860 | 471 | 869 |
| April | 4,968 | 5,193 | 244,605 | 2,508 | 128,057 | 977 | 37,530 | 1,048 | 39,979 | 511 | 888 |
| May | 5,143 | 5,535 | 239,877 | 2,647 | 121,035 | 997 | 42,739 | 1,063 | 39,482 | 439 | 766 |
| June | 5,378 | 5,655 | 242,287 | 2,748 | 114,074 | 1,037 | 53,679 | 1,069 | 40,124 | 498 | 838 |
| July | 5,484 | 5,882 | 240,270 | 2,835 | 111,055 | 1,040 | 61,664 | 1,140 | 42,165 | 486 | 806 |
| August | 5,664 | 6,067 | 237,393 | 2,932 | 107,067 | 1,089 | 68,426 | 1,148 | 40,979 | 501 | 839 |
| September | 5,888 | 6,059 | 242,311 | 2,849 | 105,748 | 1,180 | 78,270 | 1,178 | 41,966 | 525 | 859 |
| October | 5,900 | 6,077 | 246,424 | 2,875 | 105,764 | 1,217 | 85,643 | 1,250 | 45,004 | 510 | 896 |
| November | 5,891 | 6,085 | 249,525 | 2,859 | 109,005 | 1,218 | 86,113 | 1,240 | 45,048 | 466 | 891 |
| December | 5,719 | 6,143 | 248,463 | 2,879 | 116,769 | 1,343 | 71,948 | 1,306 | 40,750 | 530 | 974 |
| **1951:** | | | | | | | | | | | |
| January | 5,907 | 6,450 | 243,107 | 2,962 | 128,479 | 1,427 | 58,424 | 1,368 | 40,317 | 499 | 977 |
| February | 5,932 | 6,454 | 236,978 | 2,914 | 137,635 | 1,398 | 48,076 | 1,357 | 38,580 | 454 | 932 |
| March | 6,040 | 6,398 | 235,956 | 2,901 | 142,186 | 1,307 | 43,170 | 1,354 | 37,282 | 544 | 944 |
| **Mar., 1951 Change:** | | | | | | | | | | | |
| In Month | +108 | —56 | —1,022 | —13 | +4,551 | —91 | —4,906 | —3 | —1,298 | +90 | +12 |
| In Year | +1,162 | +1,062 | —5,274 | +362 | +8,420 | +369 | +5,393 | +200 | —4,578 | +73 | +75 |
| **Week Ended:** | | | | | | | | | | | |
| 4-14-51 | 6,120 | 6,127 | 237,106 | 2,767 | 139,431 | 1,213 | 43,203 | 1,262 | 36,826 | 435 | 948 |
| 4-15-50 | 4,999 | 5,116 | 241,324 | 2,403 | 133,458 | 967 | 37,499 | 1,077 | 39,881 | .... | .... |

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# Monthly News Analysis

## Materials To Be Scarcer But Eventually Adequate

Steel tubular goods and other metal products required by the petroleum industry are due to continue in short supply at least through 1951 and 1952, with the pinch probably becoming sharper after the middle of this year. For the longer-term future, however, the materials outlook is somewhat brighter, as steel, aluminum, and other plants are being expanded, while many special defense needs will have been fulfilled within a couple of years. Under defense plans that have been revealed in Washington, there is hope of sharply stepped up production that will provide more adequate supplies and permit gradual loosening of materials controls and other restrictions beginning in 1953.

**The petroleum industry will be helped to secure essential supplies of materials for defense facilities and general operations through priorities administered by the Petroleum Administration for Defense, which will seek the materials from the National Production Authority.**

PAD has had assurance from NPA that insofar as possible, oil and gas industry steel needs as certified by PAD will be provided, including enough to drill 43,400 wells annually. But recent reports have cast doubt on availability of sufficient steel to sustain this volume of drilling. Such doubt was emphasized with announcement by NPA Administrator Manly Fleischmann at mid-April that a Controlled Materials Plan would be put in operation July 1. He said that inauguration of the plan, while meeting military and urgent defense requirements, probably would involve cutbacks in metal supplies even for "indispensable" industries, presumably including oil and gas. Fleischmann said he expected demands of military and specific defense supporting programs for three controlled metals (steel, copper, and aluminum) to equal or exceed available supplies. NPA will then have to cut back these requirements in order to leave some supplies for consumer durable goods, which will not be covered under CMP. Leftover materials will be controlled, he said, through some kind of "limitation" orders.

While defense supporting industries may not get all materials needed, the government will continue to encourage actively the expansion of these industries through accelerated tax amortization.

### MRO Programs Exempt

To be exempted from CMP will be programs for MRO (maintenance, repair, and operating) supplies, which will be handled through materials "set aside." Applications for these supplies in the oil and gas industries are handled by PAD under NPA's Order M-46.

Forms will be available at NPA offices about May 1 for producers to report to NPA their detailed requirements of steel, copper, and aluminum. Products for which application forms will be required by NPA include, among others, oil field machinery, pumps, compressors, heat exchangers, tin cans, tanks, truck trailers, metal shipping containers, measuring and dispensing pumps and lubrication equipment, storage batteries, oil burners, and all heating and cooking equipment except residential.

**In handling applications for priorities, PAD in early April issued a new form affecting drill pipe, which is in extremely short supply, making it necessary for PAD to have additional information.**

Oil and gas operators seeking priorities assistance in placing orders for drill pipe now must apply to PAD on Form PAD-17-DP. The new form combines an inventory report and an application for approval of either emergency or quarterly requirements. When approved by PAD, the form may be used as authorization for placing DO-48E or DO-48 ratings on orders for drill pipe. As drill pipe, unlike casing and tubing, is used repeatedly in drilling wells, the inventory and use history section of the new form calls for a service record of pipe held in inventory. Information is required also on total purchases of pipe by each operator during 1950, as well as the number and location of rotary drilling rigs.

Forms PAD-15, 16, and 17, previously distributed to the industry, now may be used only in applying for priorities assistance in placing orders for casing or tubing, although they originally were intended to cover also drill pipe. On approval by PAD, those forms provide DO-48E or DO-48 ratings on orders for casing or tubing.

Priority rating DO-48E, available since April 1, will be approved by PAD only on orders for drill pipe, casing, or tubing to be used for wildcat drilling and emergency oil and gas well drilling purposes, such as meeting offset or drilling obligations. For filling these orders, 5 percent of tubular goods production is being set aside at warehouses in 13 cities around the country. Rating DO-48 may be obtained, through PAD, effective July 1, to obtain drill pipe, casing, and tubing for normal operating purposes. Effective March 15, oil and gas operators could use self-executed priority rating DO-97 in obtaining MRO supplies and laboratory equipment.

### How to Get Forms

PAD has widely distributed among operators its forms dealing with priorities, together with explanatory letters. The forms can be obtained by writing to Petroleum Administration for Defense, attention Materials Division, New Interior Building, Washington 25, D. C. Forms can be obtained also from state regulatory agencies, trade associations, and oil field supply companies.

**Frank Watts, PAD's director of materials, has stated that while materials are scarce and will remain so in 1951 and 1952, supplies eventually will increase as new steel and aluminum mills come into production and as various current emergency needs for materials are fulfilled. He urges operators to do their best, therefore, to solve their current problems themselves, although promising that if earnest individual efforts fail, PAD will extend every reasonable aid.**

PAD also has the responsibility of handling priorities for manufacturers and fabricators of drilling rigs, engines, motors, valves, pumping units, sucker rods, gathering tanks, drilling bits, and other oil country machinery and equipment. Those concerns have been asked to file reports on their operations and requirements on Form PAD-21. Many of them have been having serious difficulties during recent months in obtaining materials.

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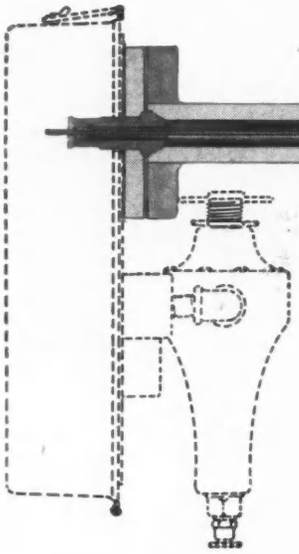

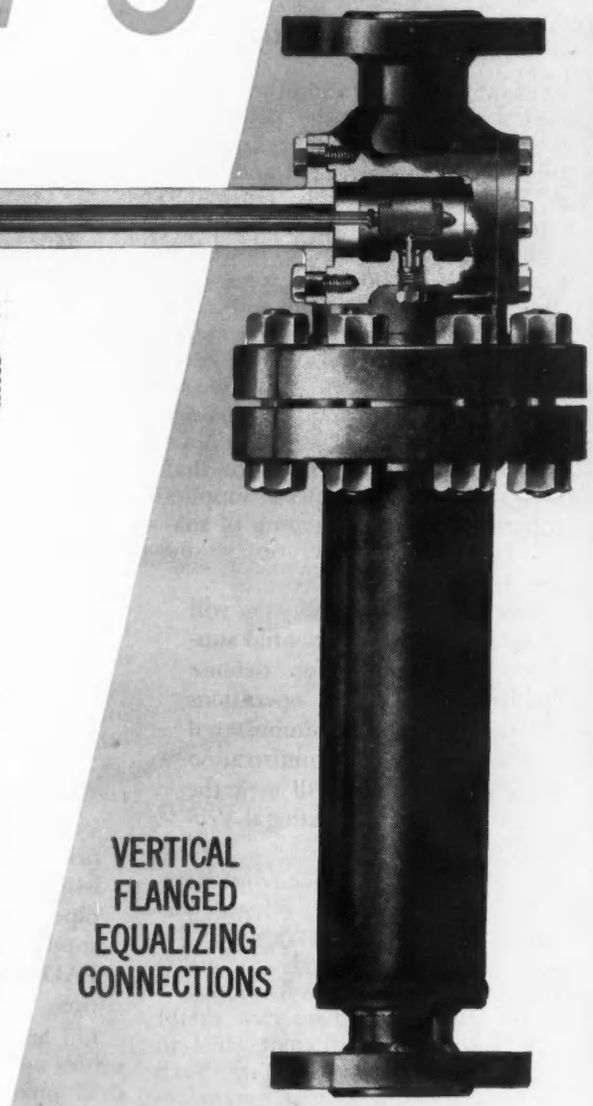


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CONTROLS

## Tidelands Gabble Goes on As Operators Sit, Suffer

Development of the offshore oil lands remains stymied by the federal government's efforts to take control, and Congress is being urged to take legislative action toward making resumption of development possible.

Enactment of "interim" tidelands legislation to permit development to proceed without necessarily resolving broad legal questions involved, is being urged by some Gulf Coast tidelands operators. They have heavy investments in the development, and in order to prevent serious losses feel they should be authorized to proceed with work, with their interests protected regardless of the outcome of controversy over title between federal and state governments. State officials of Texas have said they would not oppose reasonable interim legislation that would permit continued development, provided it does not contain anything that would prejudice Texas efforts to obtain permanent legislation restoring ownership it exercised prior to June 5, 1950, when the U. S. Supreme Court upheld federal claim to the tidelands.

Following extensive hearings in a Senate committee, Senator Long of Louisiana, member of the committee, said he doubted that the O'Mahoney interim bill (S. J. Resolution 20) could be passed. If amended to meet objections of the supporters of states' claims, said Long, the measure then probably would not be acceptable to those upholding federal claims.

Senator Long at the same time said he believed there was a "strong possibility" Congress could pass a tidelands quitclaim bill over a Presidential veto. He stated that he knew of several senators who voted five years ago to sustain President Truman's veto of a quitclaim bill who now would vote to override such a veto. "The trend to nationalization has lost ground in the past three years," he added.

## Hope Voiced FPC Will Not Regulate Gas Production

The future of oil and gas producers as free enterprisers was at stake as the Federal Power Commission in early April opened its protracted hearing at Bartlesville, Okla., to determine whether it should assert regulatory powers over Phillips Petroleum Company's natural gas production operations. Oil and gas producers generally are in danger of being regulated as utilities, with selling prices and profits fixed by the government, if FPC successfully imposes such control over the Phillips company. A week after the hearing started, questioning of Phillips officials, superintendents, and other employes still was in progress, with arguments between company attorneys and government counsel involved.

As the hearing opened, K. S. Adams, Phillips president, expressed hope that FPC "will ultimately get back on the track it has consistently followed since the Natural Gas Act was passed in 1938 and hold that it has no jurisdiction to regulate independent producers and gatherers of gas."

Intervening in support of FPC regulation were the state of Wisconsin and the city of Detroit and others. Adams said these interveners "fail to appreciate their good fortune in being supplied with this most desirable fuel from the producing states of Oklahoma, Texas, and Kansas at substantially less cost than they have been paying for less desirable fuels such as manufactured gas and coal. They seek to profit by still lower prices at the expense of the producing states and independent producers and gatherers of gas, at a time when the producers are only emerging from distress prices for their product.

"Should the interveners succeed in their shortsighted purpose," Adams continued, "they will be doing their citizens, as well as other consuming centers, a grave injustice, in my opinion. They will thereby discourage further exploration for and development of natural gas reserves and will restrict and retard and ultimately dry up the flow of natural gas to Eastern and Northern consuming centers. Congress wisely foresaw this and excluded production and gathering from the Commission's jurisdiction."

## Enough New Burners Seen To Boost Heating Oil Use

Heating oil demand will be increased materially through installations of many new oil burners this year, even though production of burners will be retarded by shortages of materials.

Although more than 1 million oil burners could be made and sold in 1951, judging by booming sales in the first quarter, manufacturers expect government restrictions to cut production to at least 20 percent less than the 925,000 units sold in 1950, which would be 740,000 units.

At the end of 1950 there were 12,200,000 residential oil burners in use in the U. S. and at least 1 million commercial and industrial oil burners in operation. More than one-third of all Americans enjoy the benefits of oil heating, these figures indicate.

## North Dakota's First Oil Well Appears Important

Not merely one new oil field but possibly a series of fields over a potentially large new oil province may be developed as a result of Amerada Petroleum Corporation's recent completion of North Dakota's first oil well.

The wildcat, Clarence Iverson 1, is in C SW SW 6-115n-95w, Williams County, on the Nesson Anticline, in the large Williston Basin. It is 35 miles northeast of Williston and nine miles from Tioga, in the northwestern corner of North Dakota, adjacent to Montana and Saskatchewan. The well flowed 307 barrels of 53-55 gravity oil in 17 hours through three-quarter-inch choke and yielded gas at an estimated rate of 5 to 6 million cubic feet daily. On a later test it flowed 159 barrels in 13 hours through three-quarter-inch choke.

Production came through 120 shot perforations at 11,630-60 feet, following acid treatment of 4000 gallons, with total depth 11,744 feet, possibly in the Silurian. Producing formation is believed to be Devonian, and the lime pay is said to have some characteristics of the Devonian reef that yields prolific production in Canada to the northwest. The well's early performance gave promise that a commercial field had been opened.

The well is near the crest of an anticline outlined by seismograph. It is somewhat north and east of the center of the Williston Basin, about two-thirds of which fills up the northwest corner of North Dakota, with the other third extending westward into the northeast corner of Montana. The basin ends roughly along the Canadian border on the north.

The North Dakota producer is a very "rank" wildcat, being more than 150 miles from production of any kind (small gas and oil areas in eastern and northern Montana) and several hundreds of miles from nearest important fields in Canada to the north, Montana to the west, Wyoming to the southwest, and western Nebraska to the south. To the east and the southeast, nearest oil fields are in Michigan and Illinois.

Though far removed from established fields, the western half of North Dakota has had active leasing and geophysical prospecting since discovery of oil at Leduc in Alberta, Canada, in early 1947, based on hopes of similar petroleum accumulations. The western half of the state embraces an extensive sedimentary basin where sedimentary rocks have been deposited in thickness of as much as 14,000 feet in the deepest part. Several of these formations have

yielded oil and gas elsewhere in the U. S. and Canada.

Amerada has a large lease block around its discovery, and numerous other major companies and independent operators have acreage in North Dakota, with about three-fourths of the state under lease.

## High Demand for Oil in California Reflects War

New locations, current production, and the inventory position in California so far this year reflect the above-normal demand that has continued since the start of the Korean War. As of April 7, the total of new wells staked this year was 613, as compared with 470 at the same date last year.

Crude production, hovering around 965,000 barrels daily in recent weeks, is over 100,000 barrels per day higher than at this time last year. Stocks on hand reflect also a drain on products from storage. Total stocks of gasoline, kerosine, distillate fuel oil and residual fuel on April 7 amounted to 42,371,000 barrels, 9 million less than a year previously. Residual fuel, the "problem child" of California inventories only a year or so ago, dropped below 17 million barrels during the week ended April 7 and were nearly 5 million barrels lower than at the same time last year.

## American Concessions in Arabia Not in Jeopardy

Relations between Arabian American Oil Company, in which his company holds a 30 percent interest, and King Ibn Saud of Saudi Arabia, are excellent, according to R. G. Follis, chairman of the board of Standard Oil Company of California.

Commenting on his impressions gathered while on a five-week air trip around the world, Follis said he visited the Saudi Arabian King and Crown Prince and found that an atmosphere of good will existed toward the Americans. The company's renegotiation of the concession has brought about a great deal of satisfaction. "I do not think that what has happened in Iran is around the corner in Saudi Arabia," Follis said. "In fact, the Saudi Arabian government is now equal partners with Aramco, without putting up the capital." He said that in addition to the increased income that Saudi Arabia was receiving from renegotiation of the concession, Aramco was proceeding with its program to improve the Arabs' health and to educate them to move up in the organization.

## Alberta To Be Slow in Permitting Gas Exports

The government of Alberta, Canada, is expected to insist that a 30- to 50-year supply of natural gas be developed in the province before it will authorize exports. It also probably will require that a good part of any permitted gas exports be obtained from areas that presently are beyond the economic reach of the Central Alberta area. It is believed, therefore, that natural gas that has been developed in the remote Peace River area probably will be included among those areas that would be tapped by any gas line exporting gas to the U. S.

If and when a permit ever is issued for export of natural gas to the Pacific Northwest area, the all-Canada route probably would be favored, because of national pride and other reasons, over other routes that have been proposed by companies seeking an export license from Alberta.

## Texas Gas To Stimulate Industry in California

Natural gas is now being delivered through the new "super inch" (34-inch) pipe line to the San Francisco Bay area from Texas and New Mexico fields at the rate of 200 million cubic feet per day. The Pacific Gas and Electric Company has announced that early next fall, when compressor plant installations are completed, deliveries will be doubled to 400 million cubic feet daily representing 157.68 trillion British thermal units per year. The newly available supply of energy is expected to have considerable effect in stepping up industrial expansion in California.

## Private Capital to Answer Refinery Expansion Need

Needs for U. S. refinery expansion in the next several years are expected to be fulfilled largely through private financing and without much recourse to special loans under the Defense Production Act or to government owned plants. Construction of new plants will be encouraged by material priorities and accelerated depreciation for income tax purposes under the government's plan of aiding defense projects. Plants already approved for tax privileges will require an investment of $318 million and will increase refining capacity by 370,000 barrels daily.

U. S. refining capacity must be increased 700,000 barrels a day by the end of 1952 and 1 million barrels by end of 1953, according to Bruce K. Brown, deputy administrator of Petroleum Administration for Defense. The capacity must be 1,600,000 barrels a day above the present level by the end of 1956, he added. The statements were made at the meeting of the Western Petroleum Refiners Association at San Antonio early in April.

These increases in crude throughput capacity will be necessary to take care of normal petroleum products consumption and also in order to assure essential production of special military products, such as aviation gasoline, jet fuel, and benzine.

There is also a special need, said Brown, for greater dispersal of refineries to safer, interior sites. Difficulty in securing such dispersal may be expected, however, as refiners generally find it economically advantageous to concentrate facilities in large plants on the coasts and inland waterways and to make extensive use of products pipe lines to serve many inland consuming areas.

Spokesmen for PAD have indicated that production rates for aviation gasoline and jet fuel are satisfactory for the current period but that the situation is not good from a longer-term viewpoint which might involve allout war. It takes 18 months to build alkylation plants that are needed for avgas production, it is pointed out, and it would be necessary to start building plants now that would come into production in latter half of 1952. Some shutdown alkylation plants can be put back into operation if the military will make long-term contracts to take their output and thus justify their reopening.

One of the problems of refiners is the shortage of sulfur. About 75 percent of sulfur supply goes into making sulfuric acid, and the petroleum industry is the third largest user of this acid. A new grade of jet fuel should hold down the industry's requirements for sulfur. The industry itself can provide some sulfur by installing facilities to recover sulfur from crude oil and refinery waste materials, and oil companies are asked to consider feasibility of such facilities.

An increased reserve supply of tetraethyl lead is sought, under defense plans, and to secure it, limitation of use is expected to be necessary at least until the spring of 1953, or longer if raw materials are not available. Meanwhile, the TEL shortage probably will result in lower octane automotive gasolines. No increase in TEL supply is indicated.

The photo above is another of a series of factual stories of how the Petroleum Industry is benefited by LOW COST Purchased Electric Power.

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# Completions

## Hold Lead Over 1950

IN THE first three months of this year a total of 9869 wells were completed to top the 9526 drilled in the same period of 1950 by 343 wells, or 3.6 percent. So far the industry has carried on its drilling program just about as WORLD OIL predicted it would during 1951. The forecast, based on estimates of leading drilling concerns, indicated that total wells drilled in 1951 would be 4 percent greater than the all-time high of last year.

The amount of footage drilled in this year's wells has shown an even greater increase than has the number of wells. A total of 37,758,287 feet have been penetrated as compared with 35,277,264 feet in the corresponding period of 1950. That amounted to an increase of 7 percent over last year's footage, and it also followed WORLD OIL's footage forecast to the letter, for it, too, pointed to an increase of 7 percent in footage for the year.

The trend this year has definitely been toward deeper wells. Today's tests are being carried to an average depth of 3886 feet, while the average in the first quarter of last year was 3747 feet. The average depth of each new well drilled last year was 3689 feet, and that was an all-time annual average depth record.

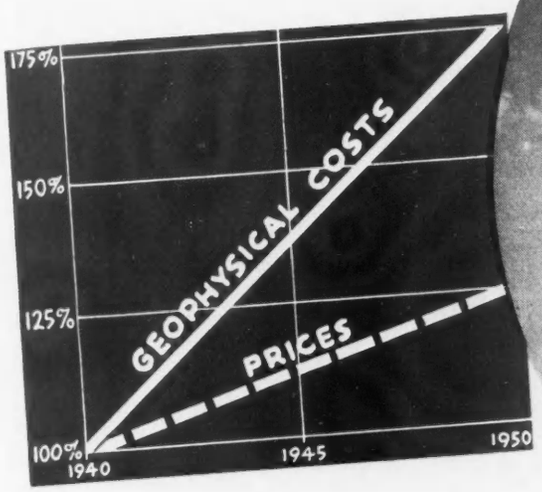
At the end of March, the number of drilling rigs at work was at a high mark for the year, and a further increase in drilling rates should be the result. A total of 4435 rigs were active at the time and that was 321 rigs, or almost 8 percent, more than were employed a year earlier.

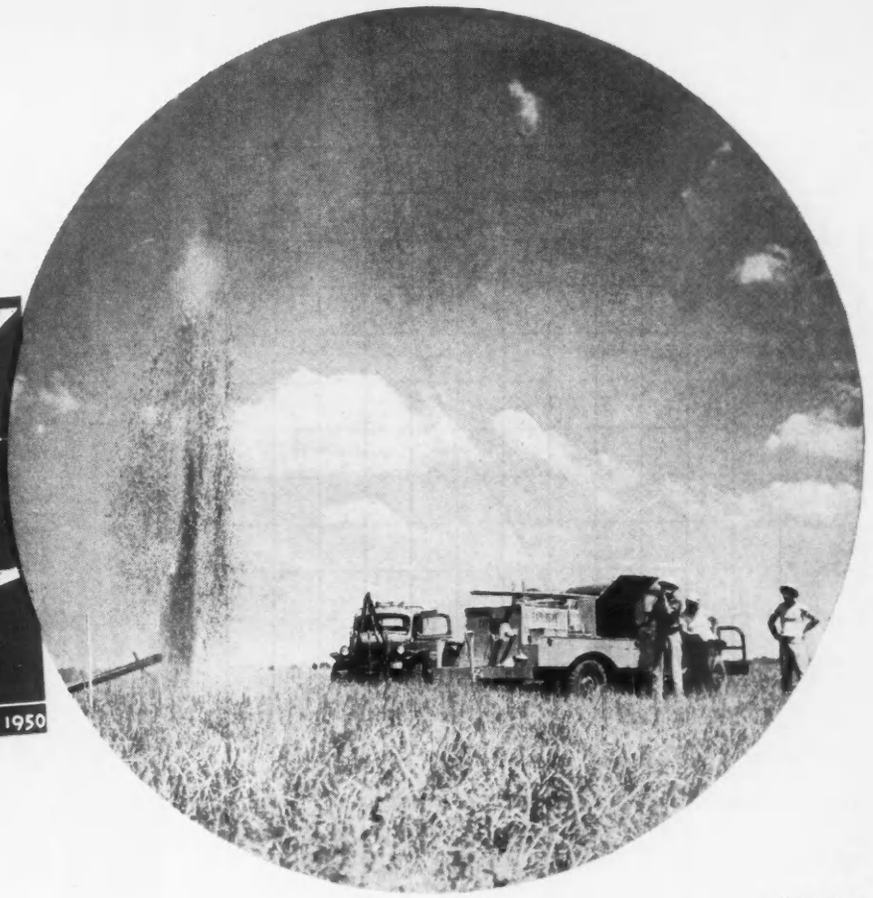
### Well Completions in the United States During March, and First Three Months, 1951

**(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the *Producers Monthly*.)**

| State or District | MONTHLY COMPLETIONS, MARCH, 1951 — NEW WELLS: Oil | Dist. | Gas | Dry | Water Input | Gas Input | Water Disposal | Total New | Total Drilled Deeper | TOTAL COMPLETIONS: Mar., 1951 | Feb., 1951 | Mar., 1950 | Footage March, 1951 | CUMULATIVE TOTALS January-March: Wells 1951 | Wells 1950 | Percent Diff. | Footage, 1951 | Footage, 1950 | Rigs in Operation (Drilling, Rigging-Up and Shut down): Mar. 31, 1951 | Feb. 28, 1951 | Mar. 31, 1950 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 2 | | | 1 | | | | 3 | | 3 | 4 | 3 | 15,821 | 14 | 8 | + 75.0 | 67,235 | 26,720 | 9 | 6 | 1 |
| Arizona | | | | 1 | | | | 1 | | 1 | | | 180 | 2 | | | 3,820 | | | 3 | 5 |
| Arkansas | 16 | | | 15 | | | | 31 | | 31 | 18 | 32 | 125,027 | 83 | 90 | — 7.8 | 305,205 | 289,924 | 25 | 30 | 22 |
| California | 148 | | 5 | 43 | 1 | | | 197 | 11 | 208 | 160 | 148 | 797,423 | 566 | 456 | + 24.1 | 2,129,472 | 1,867,750 | 220 | 227 | 194 |
| Colorado | 6 | | | 4 | | | | 10 | | 10 | 14 | | 48,607 | 41 | 7 | +485.7 | 195,558 | 19,275 | 26 | 17 | 14 |
| Florida | | | | | | | | | | | | 2 | | | 6 | —100.0 | | 41,116 | | 1 | 1 |
| Georgia | | | | | | | | | | | | 1 | | | 2 | —100.0 | | 9,075 | | | |
| Idaho | | | | | | | | | | | 1 | 1 | | 1 | 1 | | 12,844 | 3,812 | | | 2 |
| Illinois | 33 | | 1 | 62 | | | | 96 | | 96 | 133 | 145 | 252,406 | 401 | 453 | — 11.5 | 992,453 | 869,633 | 172 | 155 | 171 |
| Indiana | 23 | | | 46 | | | | 69 | | 69 | 45 | 112 | 132,232 | 211 | 299 | — 29.4 | 381,690 | 515,993 | 190 | 202 | 150 |
| Kansas | 155 | | 25 | 112 | | | 2 | 294 | | 294 | 288 | 280 | 988,530 | 880 | 788 | + 11.7 | 2,973,024 | 2,589,996 | 366 | 341 | 269 |
| Kentucky | 32 | | 19 | 20 | | | | 71 | | 71 | 66 | 75 | 145,866 | 228 | 195 | + 16.9 | 458,015 | 370,054 | 84 | 89 | 85 |
| Louisiana | 93 | 8 | 15 | 62 | 1 | | | 179 | 1 | 180 | 117 | 178 | 1,097,152 | 493 | 558 | — 11.7 | 3,302,063 | 3,450,158 | 196 | 204 | 238 |
| North Louisiana | 53 | 4 | 11 | 37 | | | | 105 | | 105 | 50 | 93 | 361,962 | 241 | 277 | — 13.0 | 885,967 | 1,027,638 | 62 | 75 | 67 |
| South Louisiana | 40 | 4 | 4 | 25 | 1 | | | 74 | 1 | 75 | 67 | 85 | 735,190 | 252 | 281 | — 10.3 | 2,416,096 | 2,422,520 | 134 | 129 | 171 |
| Maryland | | | 3 | | | | | 3 | | 3 | 1 | 1 | 12,082 | 6 | 1 | +500.0 | 22,879 | 3,612 | 14 | 10 | 1 |
| Michigan | 22 | | 2 | 41 | | | | 65 | | 65 | 46 | 58 | 172,633 | 151 | 179 | — 15.7 | 384,302 | 448,992 | 95 | 108 | 132 |
| Mississippi | 9 | 1 | | 17 | | | | 27 | | 27 | 15 | 33 | 789,852 | 65 | 88 | — 26.1 | 448,772 | 656,706 | 26 | 31 | 32 |
| Missouri | | | | | | | | | | | | 7 | | | 12 | —100.0 | | 9,667 | 5 | 5 | 9 |
| Montana | 5 | | | 1 | | | | 6 | | 6 | 8 | 15 | 16,046 | 33 | 32 | + 3.1 | 74,381 | 127,665 | 26 | 22 | 16 |
| Nebraska | 4 | | 2 | 7 | | | | 13 | | 13 | 7 | 6 | 55,490 | 30 | 16 | + 87.5 | 133,491 | 62,809 | 13 | 11 | 4 |
| Nevada | | | | | | | | | | | 1 | | | 1 | | | 10,314 | | 1 | 2 | |
| New Mexico | 23 | | 3 | 11 | | | | 37 | 2 | 39 | 44 | 42 | 154,943 | 142 | 146 | — 2.7 | 659,051 | 680,946 | 129 | 125 | 71 |
| New York | 25 | | | | 17 | | | 42 | | 42 | 38 | 45 | 59,552 | 114 | 175 | — 34.9 | 159,718 | 246,609 | 71 | 75 | 78 |
| North Dakota | | | | 1 | | | | 1 | | 1 | | | 5,609 | 1 | | | 5,609 | | 2 | 2 | |
| Ohio | 21 | | 18 | 29 | | 2 | | 70 | 1 | 71 | 41 | 75 | 146,657 | 198 | 211 | — 6.2 | 421,961 | 466,822 | 123 | 128 | 137 |
| Oklahoma | 224 | 1 | 20 | 145 | 11 | | | 401 | 11 | 412 | 315 | 424 | 1,436,377 | 1,348 | 1,200 | + 12.3 | 4,875,999 | 4,156,248 | 575 | 545 | 553 |
| Pennsylvania | 38 | | 19 | 5 | 37 | 3 | | 102 | 1 | 103 | 78 | 116 | 185,266 | 292 | 357 | — 18.2 | 528,938 | 660,181 | 219 | 217 | 191 |
| South Dakota | | | | | | | | | | | | | | | 1 | —100.0 | | 5,710 | | | |
| Tennessee | | | | | | | | | | | | | | | 1 | —100.0 | | 1,430 | 6 | 6 | 8 |
| Texas | 874 | 20 | 76 | 533 | 2 | | | 1,505 | 32 | 1,537 | 1,119 | 1,463 | 6,602,559 | 4,225 | 3,946 | + 7.1 | 17,864,873 | 16,634,802 | 1,534 | 1,482 | 1,407 |
| Dist. 1 S. Central | 25 | | | 27 | | | | 52 | 2 | 54 | 37 | 45 | 148,308 | 155 | 112 | + 38.4 | 397,950 | 324,737 | 43 | 43 | 30 |
| Dist. 2 Middle Gulf | 31 | 3 | 12 | 27 | | | | 73 | 2 | 75 | 37 | 53 | 428,700 | 191 | 131 | + 45.8 | 1,076,657 | 781,495 | 56 | 56 | 56 |
| Dist. 3 Upper Gulf | 63 | 8 | 9 | 44 | | | | 124 | | 124 | 92 | 138 | 805,971 | 356 | 366 | — 2.7 | 2,193,732 | 2,112,691 | 141 | 128 | 117 |
| Dist. 4 L. Gulf-S.W. | 80 | 2 | 11 | 55 | | | | 148 | | 148 | 107 | 149 | 752,487 | 392 | 388 | + 1.0 | 1,983,020 | 1,817,398 | 124 | 120 | 113 |
| Dist. 5 E. Central | 22 | | 2 | 31 | | | | 55 | 1 | 56 | 40 | 13 | 154,801 | 124 | 39 | +217.9 | 410,566 | 187,518 | 35 | 34 | 27 |
| Dist. 6 Northeast | 53 | 2 | 4 | 13 | | | | 72 | | 72 | 41 | 61 | 352,147 | 171 | 164 | + 4.3 | 848,426 | 747,875 | 34 | 33 | 33 |
| Dist. 7-B N. Central | 86 | | 5 | 99 | | | | 190 | 3 | 193 | 176 | 174 | 576,205 | 577 | 455 | + 26.8 | 1,616,826 | 1,410,716 | 185 | 175 | 150 |
| Dist. 7-C W.Central | 86 | 4 | 1 | 49 | | | | 140 | 4 | 144 | 89 | 88 | 600,845 | 347 | 217 | + 60.0 | 1,405,472 | 903,494 | 145 | 131 | 86 |
| Dist. 8 West | 274 | | | 57 | 1 | | | 332 | 17 | 349 | 268 | 338 | 1,824,517 | 983 | 960 | + 2.4 | 5,232,723 | 5,131,651 | 463 | 432 | 499 |
| Dist. 9 North | 131 | 1 | | 128 | 1 | | | 261 | 3 | 264 | 196 | 344 | 790,974 | 715 | 865 | — 17.4 | 2,058,483 | 2,419,757 | 225 | 237 | 192 |
| Dist. 10 Panhandle | 23 | | 32 | 3 | | | | 58 | | 58 | 36 | 60 | 167,604 | 214 | 249 | — 14.1 | 641,018 | 797,470 | 83 | 93 | 104 |
| Utah | | | | | | | | | | | 3 | 2 | | 5 | 6 | — 16.7 | 13,537 | 19,083 | 14 | 11 | 8 |
| Virginia | | | | | | | | | | | | | | | | | | | 2 | 1 | 1 |
| Washington | | | | | | | | | | | | 1 | | | 1 | —100.0 | | 6,688 | | | 1 |
| West Virginia | 5 | | 27 | 6 | | | | 38 | 2 | 40 | 62 | 53 | 111,976 | 176 | 160 | + 10.0 | 506,414 | 377,178 | 200 | 205 | 261 |
| Wyoming | 42 | | 2 | 23 | | | | 67 | 1 | 68 | 45 | 32 | 334,113 | 162 | 131 | + 23.7 | 826,669 | 658,610 | 92 | 78 | 52 |
| Total U. S. | 1,800 | 30 | 237 | 1,185 | 69 | 5 | 2 | 3,328 | 62 | 3,390 | 2,669 | 3,350 | 13,086,490 | 9,869 | 9,526 | + 3.6 | 37,758,287 | 35,277,264 | 4,435 | 4,339 | 4,114 |

By J. E. KASTROP
WORLD OIL Staff



—Shell Photo

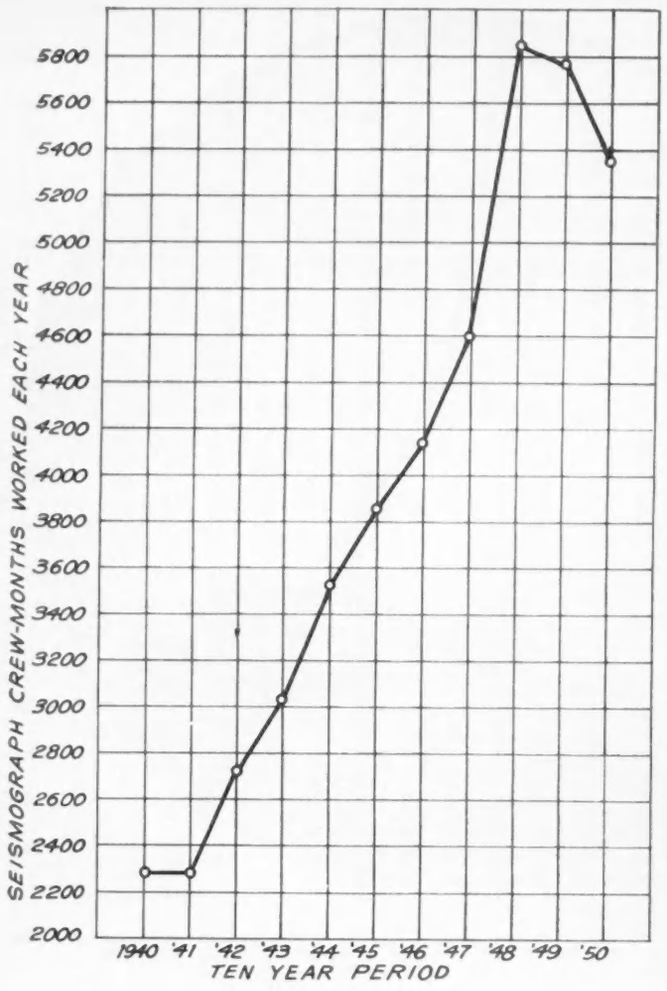
It requires highly skilled personnel and the most efficient equipment to search out the more obscure oil traps.

# *Geophysical* Costs Outrun Prices

ONE OF the most important segments of the petroleum industry is feeling the pressure from steadily rising operating costs against a relatively small increase in prices to its clients. Although some geophysical companies were successful in making slight increases in prices at the opening of 1951, others are digging into badly-needed cash reserves to make up the difference to continue operations. Larger firms are feeling the squeeze more severely than the two- or four-crew companies, and unless prices are brought more nearly in line with costs, their operations will be hampered at the ultimate cost of quality and advancement of geophysics.

It has been estimated that approximately 90 percent of the oil industry's cost for geophysical exploration is annually incurred by seismograph operations, and for that reason the data presented here are confined solely to this method of surveying. The most revealing fact uncovered in this industry-wide survey showed that since 1940, operating costs to the contractor based on a per-crew month have increased an average of 75 percent. In this same 10-year period, the contractor's charges to his clients, based on a per-crew-month rate has increased on the average of only 28 percent. Even in the light of this unfavorable trend, the geophysical contractors were able to increase their proficiency by 63 percent. Since seismograph crews are generally contracted on a per-month basis, this increase in proficiency of the contractor did not help him in his costs, but provided the industry with better

**HERE ARE the facts concerning the business status of the American geophysical contractor. WORLD OIL surveyed a cross-section of geophysical contracting companies who specialize in seismograph exploration. The results shown on these pages are averages and represent the condition of the geophysical contractors as a whole. Prominent company executives were interviewed and their thoughts are incorporated in this study. The wide deviation between seismograph costs and income is placing the professional contractor in a precarious position, according to these findings.**




Seismograph activity in U. S. 1940-1950

—Shell Photo

Trained scientists and technicians make and interpret the maze of geophysical data required by any successful exploration program.

information on which to select prospective drilling sites.

The most noted increase in the contractor's costs has been for equipment. The survey showed that overall equipment costs have nearly doubled in the past ten years. Since 1945, they have increased 50 percent. This increase has been due primarily to higher wages paid to production workers. For example, in 1945, average wages paid by one instrument manufacturer were about $1.13 per hour, and today are $1.52 per hour . . . an increase of almost 35 percent. During this same period, due to the fact that the suppliers were paying higher wages, the cost of material going into the manufacture of geophysical equipment has gone up proportionately.

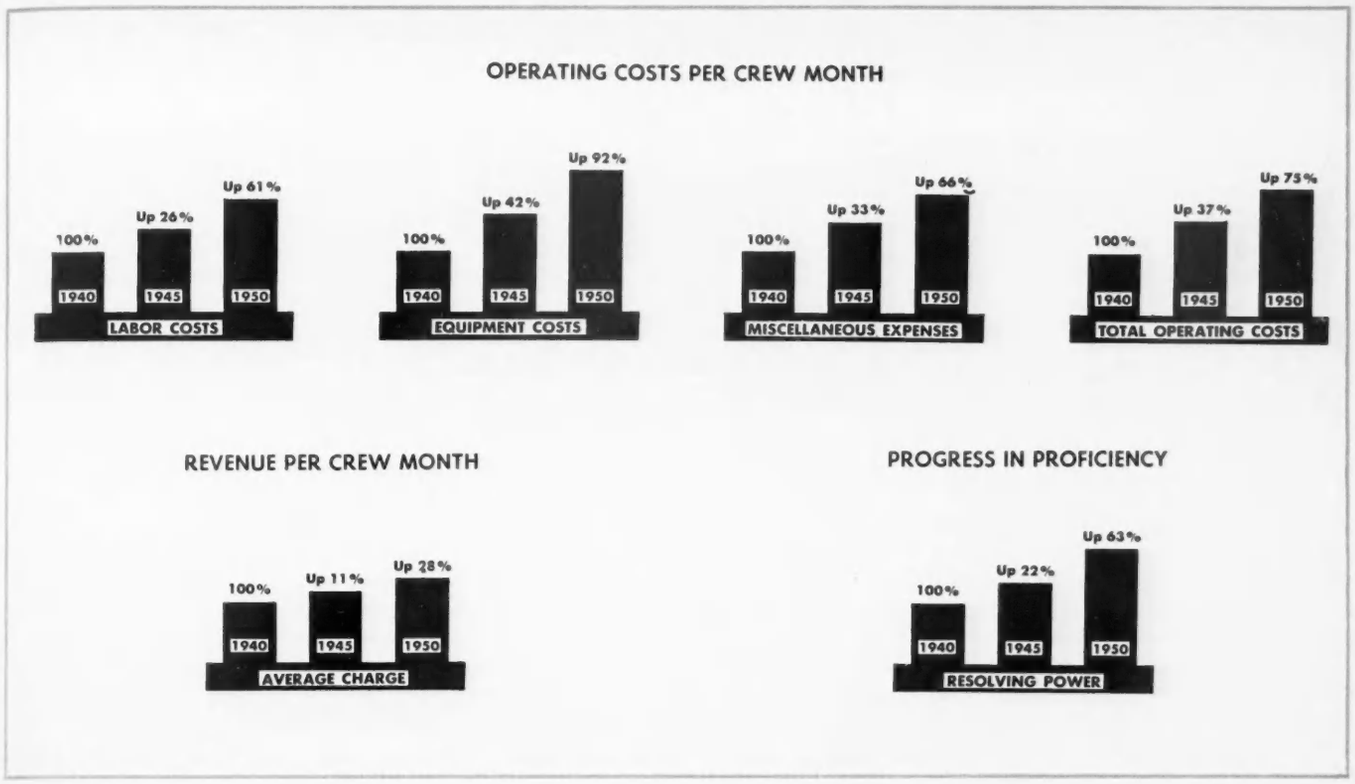
In 1945 there was a considerable amount of government surplus electronic material available at a cost lower than prevailing commercial rates. This supply is not available today. Vehicles, which make up a large part of the capital investment in a seismograph unit, have taken large jumps in prices even in the past six months. Due to the hazardous nature of seismograph surveying in rough terrain, these vehicles wear rapidly and their upkeep is high and replacement frequent.

It is conservatively estimated that the capital investment in an average complete seismograph unit with two shot-hole drill rigs (an average for the U. S.) is approximately $75,000. Amortization for most of this equipment is about five years, not because of complete destruction, but primarily due to obsolescence, although vehicles sometimes have to be replaced every other year.

Labor costs have increased an average of 61 percent since 1940, taking its biggest jump in the past five years during which time it has gone up 35 percent. Where the salaries for a complete crew averaged less than $2000 per month in 1940, they are now more than $4000 in some instances. Salaries all along the line have been increased. Management has taken more, it has required more money to attract top research personnel into geophysical work, and the salaries of clerks, stenographers and office help have gone up proportionately.

Miscellaneous expenses in this same ten-year period have leaped 66 percent. These items include rent, expenses for personnel, accounting, travel, storage, and most important of all, the research which has been one of the main factors in this increase.

Although there are many ways in which a geophysical contract may be written, such as with or without the shot-hole drill rigs, and transferring the cost of explosives and drill bits as well as shot-hole casing directly to the client, it has been estimated that a typical land seismograph crew contracts for between $8000 and $9000 per month. Of course, marine seismograph crews would increase this average since water and swamp operations are considerably more expensive and involve capital investments more than double the land units. Because of the tremendous investment in seismograph equipment, the short term duration of the average geophysical contract should be taken into account in determining existing rates. While the return on investments in




seismograph work varies from one company to another, some report earnings up to 10 percent while others do no better than 8 or 9. This compares to earnings in 1945 of 20 and 25 percent on investments.

How long the current situation can last without increases in charges to the client may be summarized from the comments of some of the larger geophysical contractors having large overhead expenses due to expanded research programs. They say they must increase their rates if they are to continue in business and keep up high-quality work and maintain top-ranking research departments.

According to figures on the number of crew-months seismograph activity in the U. S. (shown in graphic form), there has been a tremendous growth in seismograph crews since 1941. The largest growth was shown between 1947 and 1948 when an average of 105 crews were added to this country's industry. The past five years witnessed the beginning of numerous seismograph companies. With new equipment that could be altered or rebuilt as changes in technique require, these companies could continue to operate on a relatively small margin of profit. This was possible, too, due to full-scale employment of all crews.

However, in 1949, many contractors were forced to lay off crews for several months, and this temporary cut in income began to take effect. Although the total crew months worked in 1949 was high and some crews were assigned to Canada, many crew months were lost from March through November. This problem of shutting down crews part of the time posed a problem for the seismograph contractor whose margin of profit was not large enough to make up the loss. This meant that new crews had to be hired when the equipment was re-employed, and this situation is not desirable since the best of personnel was not always available.

Another aspect of this problem is that when the smaller contractor and even the large ones had idle crews, they were forced to keep them busy in order to provide some job security for their top personnel. To do this, some of them worked on their own prospects. They then leased land in highly favorable areas and joined with others to drill a well. Today, there are several seismograph contracting companies that have oil production which gives them a steady income to offset any idle crews they may have. When idle, these crews are shooting for the contractor.

The health of the seismograph contracting company should be of great concern to the oil company and to the oil operator who does not have his own complete geophysical department. For these companies and operators depend almost 100 percent upon the geophysical contractor for their surveys. And it is through these surveys that they increase their oil reserves and remain in business. Should the size of the geophysical contracting companies dwindle, many of these companies would be forced to build up their own geophysical departments at great expense in order to continue exploration. Neither the contracting seismograph companies nor these operators want this to happen. And it need not happen so long as a reasonable return on the contractor's investment is assured.

What's more important to all concerned is the quality of results which the prudent seismograph contractor is capable of producing. It takes better equipment and skillful personnel to produce good results, both of which require large sums of money to obtain and keep operating. A large share of the geophysical research burden is carried by many of the larger contracting companies. Large oil companies with research facilities are well aware of this tremendous research burden. This represents a big overhead expense and requires outstanding scientists. Many geophysical leaders in the industry have pointed out that new petroleum reservoirs are becoming more difficult to find as time passes, and the salvation of this situation is an intensified research program to find new and better ways of taking a closer and more accurate look into the earth's crust.

To do this job adequately, the contractor must make large expenditures, and the money for his research program must come from his earnings

on the working crews. With a large overhead, he cannot compete with the smaller seismograph company, but he is in a position to offer his client the benefits of his research and top scientific skill. This is a continuing struggle between the two components and it is the client who must decide that which he wants. However, it is well for him to keep in mind that his ultimate aim is finding oil, and the most accurate picture of subsurface conditions is none too good for this purpose.

**Role of the Geophysical Contractor**

The U. S. oil industry finds itself in a precarious condition in the light of world events. Demands upon it are steadily increasing at an unprecedented rate, and with the military preparedness program under way, it is anticipated that this increase in petroleum demand will continue to rise even higher. If the industry is to remain in its present condition during the coming critical years, it must find new reserves. And, what's more important today than ever before, this new oil, for the best interests of this country from a military standpoint, must be within the borders of the North American Continent.

We may justly ask, "What does this have to do with the economy of the seismograph contractor?" Because geophysics accounts for so large a part of our exploration efforts, it is a science and an art that must not be permitted to deteriorate or even stagnate. It must increase its skill in locating those areas which are favorable to the accumulation of petroleum.

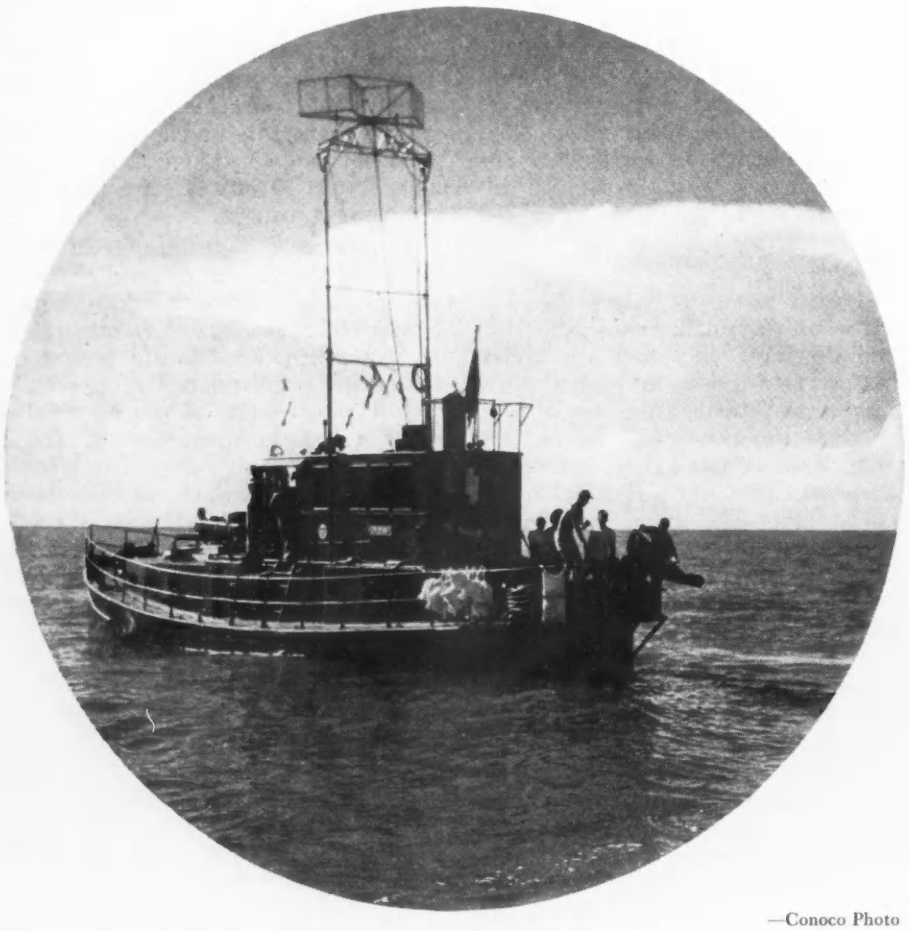
In 1950 the demand for oil in the U. S. was about 6,800,000 barrels per day, and only 5,405,000 barrels per day were produced. Current conservative estimates show the demand for petroleum in 1955 to be in the order of 8¼ million barrels per day, and by 1960 this figure will reach 9¾ million barrels daily.

Another side of this picture is not too bright. In 1940, for every wildcat drilled, there were added to this country's oil reserves about 635,000 barrels of new oil. But in 1950 only 427,000 barrels of oil were added for every wildcat drilled. In order for the U. S. to maintain its position in reserves, which in 1950 were about 13½ times greater than that year's production, 1⅔ barrels of new oil must be found for every barrel of oil produced.

Of considerable significance is the fact that the percentage of wildcats drilled of all wells completed in the U. S. is higher today than it has ever been. It is not likely that this situation will change, except that the percentage of wildcats will increase. Under such circumstances, with the cost of wildcat wells increasing rapidly, due primarily to greater depths, it is even more imperative that the industry improve its ability to locate these expensive wildcats in areas of greatest possibilities. These facts point to one strong objective: the oil finding arm of industry must continue to improve its science rapidly.

The successful geophysical contractor, like the drilling contractor, finds himself in a highly competitive business, and under the American system it is competition that fosters growth and improvement. However, there are peculiarities in geophysical exploration where severe competition has failed to bring about these desirable aspects. Instead, there have been highly competitive bidding for survey contracts, and corners cut wherever possible. In the interest of speed and economy, the resultant geophysical picture may not be a very reliable one, and the client spends good money on a survey because he took the cheapest bid, and possibly overlooked a prospect.

This situation is not new to any industry. It is true even in the oil business, and it is well known to the drilling contractor. There will always be someone to bid for a job at a cheaper price so long as there are more crews than jobs. However, it behooves the operator who asks for bids or who investigates various geophysical company charges, to keep in mind his objective, and how geophysics helps him in his objective. The outcome of a geophysical survey, coupled with geological interpretation, will determine whether or not large expenditures are to be made for drilling. Therefore, the quality of a survey is of the utmost importance, since the decision to drill or to condemn an area may depend upon it. Therefore, the best of geophysical records, the careful and skillful interpretation of these records, and their use are of the greatest importance in locating the more difficult-to-find petroleum reservoirs. Unless geophysics can continue its research and can continue to offer secure jobs to top scientists and skilled operators, the art and science of exploration geophysics will not be advanced, and the effectiveness of geophysics in finding new oil will decrease.



—Conoco Photo

**Seismograph explorations in the Gulf of Mexico are many times more costly than land operations and require the use of special vessels and equipment. Radar and radar operators as well as the ship's crew are additional expenses incurred in such surveys.**

# *Oils* in Strong Demand

By L. J. LOGAN and CECIL W. SMITH

WORLD OIL Staff

TOTAL demand for all oils in the first quarter of 1951 was 1,002,000 barrels per day or 14.8 percent greater than in the like period of 1950, having averaged 7,784,000 barrels daily, compared with 6,782,000 last year. This record-breaking first quarter demand is indicated by WORLD OIL computations (Page 62).

To meet this high demand, the industry drew heavily on all sources: domestic production of crude and natural gasoline, imports of crude and products, and storage. Domestic production of all oils averaged 6,515,000 barrels daily in the first quarter of 1951, an increase of 1,113,000 daily or 20.6 percent over the 5,402,000 barrels of the initial quarter of 1950. Crude production averaged 5,961,000 barrels per day, which was 1,040,000 barrels daily or 21.1 percent above the 4,921,000 daily of the like period last year. Natural gasoline production of 554,000 barrels daily was 74,000 a day or 15.4 percent above last year.

Total imports of 952,000 barrels daily were 150,000 a day or 18.7 percent above the 802,000 daily in last year's first quarter. Imports of crude averaged 500,000 daily against 458,000 a year earlier, and receipts of products 452,000 compared with 344,000.

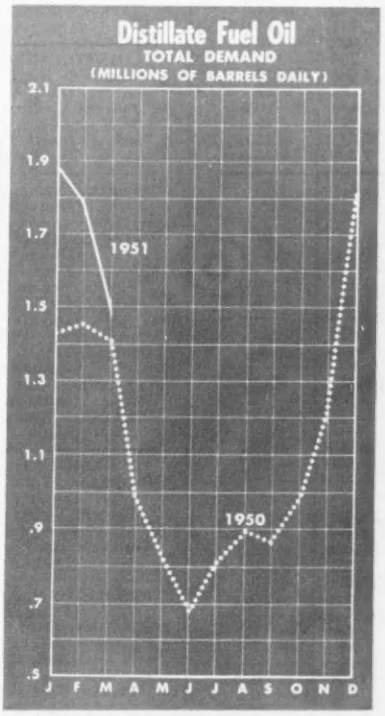
Stocks of all oils were drawn down seasonally at the rate of 317,000 barrels daily in this year's first quarter, compared with 578,000 barrels daily in last year's initial quarter.

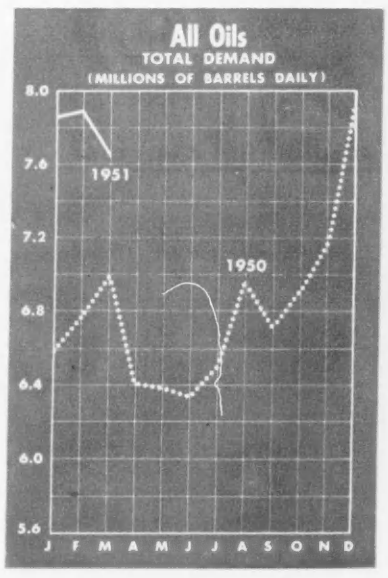
The heavy demand of the first quarter was accentuated by unusually cold weather and resultant high consumption of heating oils, but there was strong demand for all products independently of weather conditions. As compared with last year's first quarter, there were increases of 14.4 percent for motor fuel, 8.9 percent for kerosine, 19.6 percent for distillate fuel oil, 6.4 percent for residual fuel oil, and 20.7 percent for lubricants.

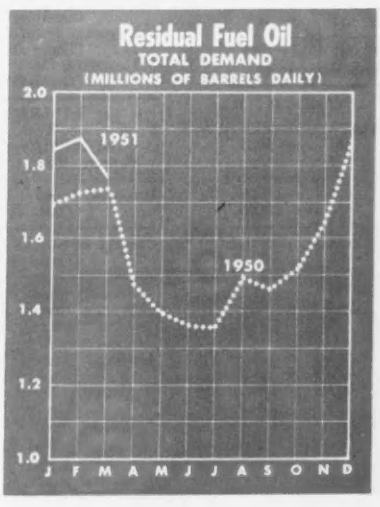
Demand for petroleum is expected to continue well above last year, though probably by lower percentages than in the first quarter. For the whole year 1951, the Supply and Transportation Division of the Petroleum Administration for Defense has estimated a total demand 10 percent above 1950. That estimate includes increases of 12.1 percent for gasoline, 9.4 percent for kerosine, 14 percent for distillate fuel, and 7.8 percent for residual.

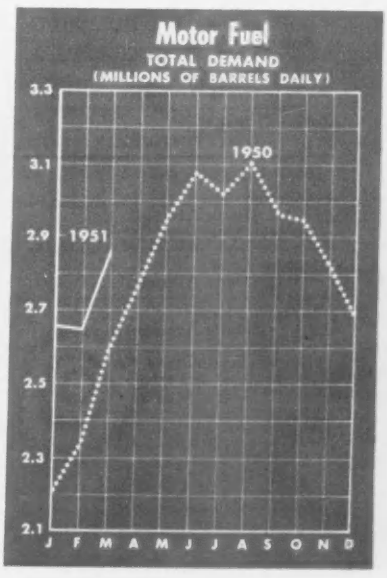
On the basis of that estimate, PAD foresees need for domestic crude production averaging 6,065,000 barrels per day in 1951 (6,160,000 daily in third and fourth quarters) and imports averaging 950,000 barrels per day. U. S. crude production averaged 6,040,000 barrels daily in March and 6,127,000 in April's first week.

PAD indicated that 95 to 100 million barrels of heating oil stocks will be needed next winter, that residual fuel oil stocks should be increased to 50 million barrels by the third quarter (from about 37 million now), and that 250 million barrels of crude stocks are essential, as compared with about 236 million now held.



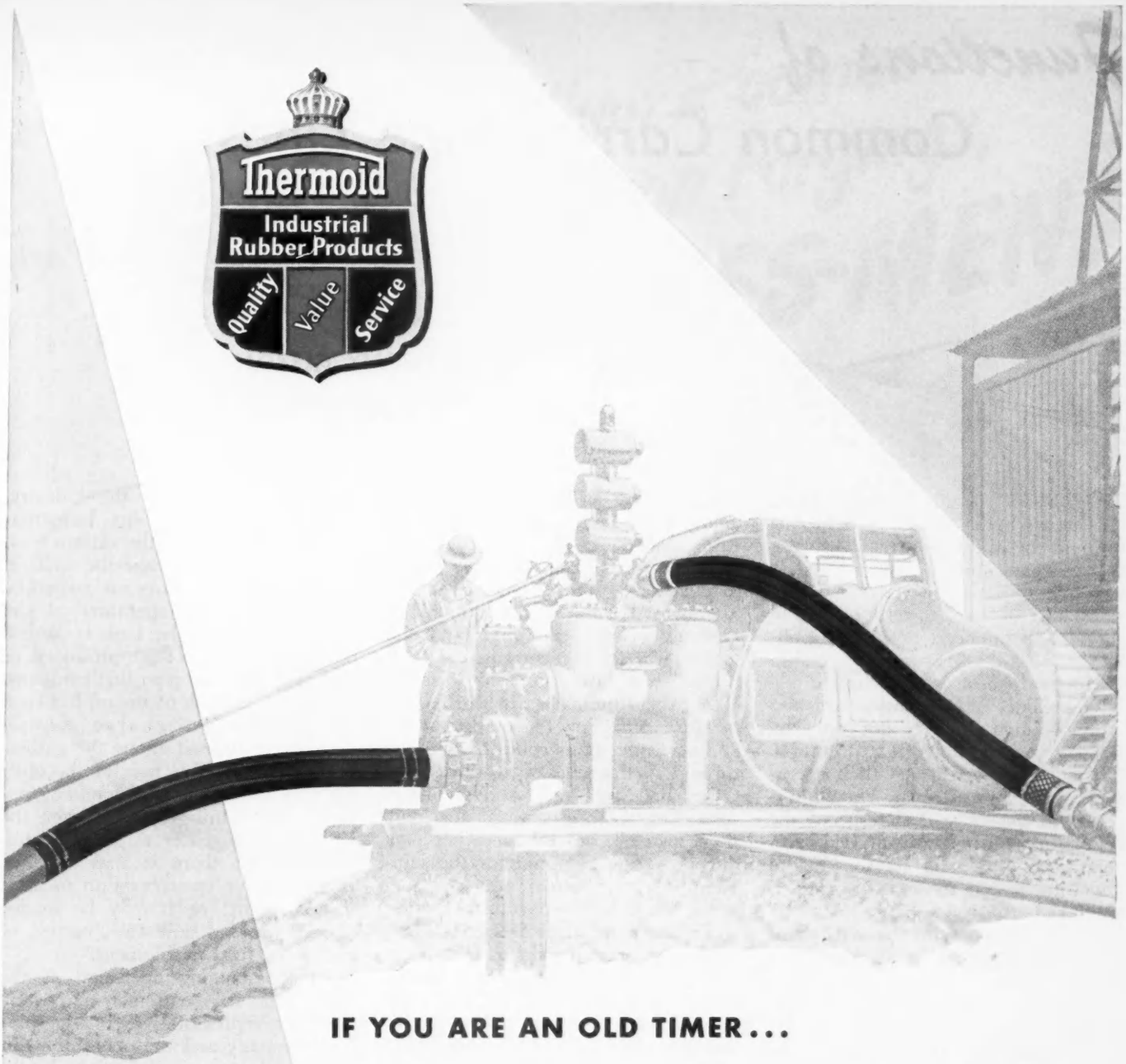
## Demand for and Supply of All Oils, Crude Oil, Motor Fuel, Kerosine, Fuel Oil and Lubricants

Sources: U. S. Bureau of Mines except February and March, 1951, estimated with aid of A.P.I. reports.

(THOUSANDS OF BARRELS)

| ITEM | First Quarter 1950 | First Quarter 1951 | Percent Change |
|---|---|---|---|
| **ALL OILS** | | | |
| Domestic Production, Total | 486,186 | 586,346 | + 20.6 |
| (Daily Average) | 5,402 | 6,515 | + 20.6 |
| Crude Petroleum | 442,876 | 536,425 | + 21.1 |
| (Daily Average) | 4,921 | 5,961 | + 21.1 |
| Natural Gasoline | 43,251 | 49,895 | + 15.4 |
| (Daily Average) | 480 | 554 | + 15.4 |
| Benzol | 59 | 26 | — 55.9 |
| (Daily Average) | 1 | ..... | — 55.9 |
| Imports, Total | 72,169 | 85,672 | + 18.7 |
| (Daily Average) | 802 | 952 | + 18.7 |
| Crude Petroleum | 41,215 | 45,035 | + 9.3 |
| (Daily Average) | 458 | 500 | + 9.3 |
| Refined Products | 30,954 | 40,637 | + 31.3 |
| (Daily Average) | 344 | 452 | + 31.3 |
| Changes in Stocks, All Oils | —52,048 | —28,531 | ..... |
| (Daily Average) | —578 | —317 | ..... |
| Stocks, Beginning of Period | 603,119 | 582,710 | — 3.4 |
| Crude Oil | 253,356 | 248,463 | — 1.9 |
| Refined Products | 342,932 | 326,892 | — 4.7 |
| Natural Gasoline | 6,831 | 7,355 | + 7.7 |
| Stocks, End of Period | 551,071 | 554,179 | + 0.6 |
| (Days' Supply) | 81 | 71 | — 12.4 |
| Crude Oil | 241,230 | 235,956 | — 2.2 |
| Refined Products | 302,133 | 310,423 | + 2.7 |
| Natural Gasoline | 7,708 | 7,800 | + 1.2 |
| Demand, Total | 610,403 | 700,549 | + 14.8 |
| (Daily Average) | 6,782 | 7,784 | + 14.8 |
| Exports, Total | 23,731 | 23,028 | — 3.0 |
| (Daily Average) | 264 | 256 | — 3.0 |
| Crude Petroleum, Total | 6,479 | 7,584 | + 17.1 |
| (Daily Average) | 72 | 84 | + 17.1 |
| Refined Products, Total | 17,252 | 15,444 | — 10.5 |
| (Daily Average) | 192 | 172 | — 10.5 |
| Domestic Demand, Total | 586,672 | 677,521 | + 15.5 |
| (Daily Average) | 6,518 | 7,528 | + 15.5 |
| **CRUDE PETROLEUM** | | | |
| **Supply:** | | | |
| Domestic Production, Total | 442,876 | 536,425 | + 21.1 |
| (Daily Average) | 4,921 | 5,960 | + 21.1 |
| Imports, Total | 41,215 | 45,035 | + 9.3 |
| (Daily Average) | 458 | 501 | + 9.3 |
| Change in Stocks | —12,126 | —12,507 | ..... |
| (Daily Average) | —153 | —139 | ..... |
| Stocks, Beginning of Period | 253,356 | 248,463 | — 1.9 |
| Stocks, End of Period | 241,230 | 235,956 | — 2.2 |
| (Days' Supply) | 44 | 36 | — 18.2 |
| Supply, Total | 496,217 | 593,967 | + 19.7 |
| (Daily Average) | 5,514 | 6,600 | + 19.7 |
| **Demand:** | | | |
| Runs to Stills, Total | 484,242 | 579,020 | + 19.6 |
| (Daily Average) | 5,380 | 6,434 | + 19.6 |
| Domestic Crude | 442,556 | 533,064 | + 20.5 |
| (Daily Average) | 4,917 | 5,923 | + 20.5 |
| Foreign Crude | 41,686 | 45,956 | + 10.2 |
| (Daily Average) | 463 | 511 | + 10.2 |
| Exports, Total | 6,479 | 7,584 | + 17.1 |
| (Daily Average) | 72 | 84 | + 17.1 |
| Transfers to Fuel Oil Stocks | 1,880 | 1,876 | — 0.2 |
| (Daily Average) | 21 | 21 | — 0.2 |
| Distillate Fuel Oil | 625 | 619 | — 1.0 |
| Residual Fuel Oil | 1,255 | 1,257 | + 0.2 |
| Used as Fuel, and Losses | 3,616 | 5,487 | + 51.7 |
| (Daily Average) | 41 | 61 | + 51.7 |
| Demand, Total | 496,217 | 593,967 | + 19.7 |
| (Daily Average) | 5,514 | 6,600 | + 19.7 |
| **KEROSINE** | | | |
| Production, Total | 30,709 | 35,876 | + 16.8 |
| (Daily Average) | 341 | 399 | + 16.8 |
| Percent Yield from Crude | 6.3 | 6.2 | ..... |
| Imports, Total | 245 | ..... | —100.0 |
| (Daily Average) | 3 | ..... | —100.0 |
| Change in Stocks | —7,887 | —6,438 | ..... |
| (Daily Average) | —88 | —71 | ..... |
| Stocks, Beginning of Period | 20,888 | 19,723 | — 5.6 |
| Stocks, End of Period | 13,001 | 13,285 | + 2.2 |
| (Days' Supply) | 30 | 28 | — 6.7 |
| Demand, Total | 38,841 | 42,314 | + 8.9 |
| (Daily Average) | 432 | 470 | + 8.9 |
| Exports, Total | 583 | 407 | — 30.2 |
| (Daily Average) | 7 | 4 | — 30.2 |
| Domestic Demand | 38,258 | 41,907 | + 9.5 |
| (Daily Average) | 425 | 466 | + 9.5 |

| ITEM | First Quarter 1950 | First Quarter 1951 | Percent Change |
|---|---|---|---|
| **MOTOR FUEL** | | | |
| Production, Total | 236,410 | 270,339 | + 14.4 |
| (Daily Average) | 2,627 | 3,004 | + 14.4 |
| Refinery Gasoline, Total | 208,591 | 239,873 | + 15.0 |
| (Daily Average) | 2,318 | 2,665 | + 15.0 |
| Percent Yield from Crude | 43.0 | 41.1 | ..... |
| Natural Gasoline, etc. | 43,251 | 49,895 | + 15.4 |
| (Daily Average) | 480 | 554 | + 15.4 |
| Less Sales of L.P.G. | 14,706 | 18,500 | + 25.8 |
| Less Transfers Cycle Prods. | 785 | 955 | + 21.7 |
| Benzol | 59 | 26 | — 55.9 |
| Imports, Total | 1 | 7 | +600.0 |
| (Daily Average) | ..... | ..... | ..... |
| Change in Stocks | +22,215 | +25,380 | ..... |
| (Daily Average) | +247 | +282 | ..... |
| Stocks, Beginning of Period | 110,417 | 116,024 | + 5.1 |
| Finished Gasoline | 103,586 | 108,669 | + 4.9 |
| Natural Gasoline | 6,831 | 7,355 | + 7.7 |
| Stocks, End of Period | 132,632 | 141,404 | + 6.6 |
| (Days' Supply) | 56 | 52 | — 7.2 |
| Finished Gasoline | 124,924 | 133,604 | + 6.9 |
| Natural Gasoline | 7,708 | 7,800 | + 1.2 |
| Demand, Total | 214,196 | 244,966 | + 14.4 |
| (Daily Average) | 2,380 | 2,722 | + 14.4 |
| Exports, Total | 5,183 | 4,481 | — 13.6 |
| (Daily Average) | 58 | 50 | — 13.6 |
| Domestic Demand | 209,013 | 240,485 | + 15.1 |
| (Daily Average) | 2,322 | 2,672 | + 15.1 |
| **DISTILLATE FUEL OIL** | | | |
| Production, Total | 90,288 | 123,907 | + 37.2 |
| (Daily Average) | 1,003 | 1,376 | + 37.2 |
| Percent Yield from Crude | 18.5 | 21.2 | ..... |
| Transfers from Crude | 625 | 619 | — 1.0 |
| (Daily Average) | 7 | 7 | — 1.0 |
| Imports, Total | 144 | 627 | +335.4 |
| (Daily Average) | 2 | 7 | +335.4 |
| Change in Stocks | —37,658 | —28,778 | ..... |
| (Daily Average) | —418 | —320 | ..... |
| Stocks, Beginning of Period | 75,435 | 71,948 | — 4.6 |
| Stocks, End of Period | 37,777 | 43,170 | + 14.3 |
| (Days' Supply) | 26 | 25 | — 3.9 |
| Demand, Total | 128,715 | 153,931 | + 19.6 |
| (Daily Average) | 1,430 | 1,710 | + 19.6 |
| Exports, Total | 3,221 | 2,585 | — 19.8 |
| (Daily Averge) | 36 | 29 | — 19.8 |
| Domestic Demand | 125,494 | 151,346 | + 20.6 |
| (Daily Average) | 1,394 | 1,681 | + 20.6 |
| **RESIDUAL FUEL OIL** | | | |
| Production, Total | 106,077 | 122,358 | + 15.3 |
| (Daily Average) | 1,178 | 1,360 | + 15.3 |
| Percent Yield from Crude | 21.8 | 21.0 | ..... |
| Transfers from Crude | 1,255 | 1,257 | + 0.2 |
| (Daily Average) | 14 | 14 | + 0.2 |
| Imports, Total | 28,794 | 37,197 | + 29.2 |
| (Daily Average) | 320 | 413 | + 29.2 |
| Change in Stocks | —18,333 | —3,468 | ..... |
| (Daily Average) | —204 | —38 | ..... |
| Stocks, Beginning of Period | 60,193 | 40,750 | — 32.3 |
| Stocks, End of Period | 41,860 | 37,282 | — 10.9 |
| (Days' Supply) | 24 | 20 | — 16.7 |
| Demand, Total | 154,459 | 164,280 | + 6.4 |
| (Daily Average) | 1,716 | 1,825 | + 6.4 |
| Exports, Total | 3,759 | 3,190 | — 15.1 |
| (Daily Average) | 42 | 35 | — 15.1 |
| Domestic Demand | 150,700 | 161,090 | + 6.9 |
| (Daily Average) | 1,674 | 1,790 | + 6.9 |
| **LUBRICANTS** | | | |
| Production, Total | 11,605 | 14,538 | + 25.3 |
| (Daily Average) | 129 | 162 | + 25.3 |
| Percent Yield from Crude | 2.4 | 2.5 | ..... |
| Imports, Total | ..... | ..... | ..... |
| (Daily Average) | ..... | ..... | ..... |
| Change in Stocks | —230 | +251 | ..... |
| (Daily Average) | —3 | +3 | ..... |
| Stocks, Beginning of Period | 9,219 | 7,849 | — 14.9 |
| Stocks, End of Period | 8,989 | 8,100 | — 9.9 |
| (Days' Supply) | 68 | 51 | — 25.0 |
| Demand, Total | 11,835 | 14,287 | + 20.7 |
| (Daily Average) | 132 | 159 | + 20.7 |
| Exports, Total | 3,350 | 3,315 | — 1.1 |
| (Daily Average) | 37 | 37 | — 1.1 |
| Domestic Demand | 8,485 | 10,972 | + 29.8 |
| (Daily Average) | 95 | 122 | + 29.3 |




## IF YOU ARE AN OLD TIMER...

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speeds rig-up and tear-down time between mud-pump and standpipe. Eliminates vibration that causes loosened connections, and avoids sharp angles that cause pressure loss and turbulence. Full flow couplings securely anchored for the life of the hose. Steel cables provide maximum flexibility—every length pre-tested to 5000 psi.

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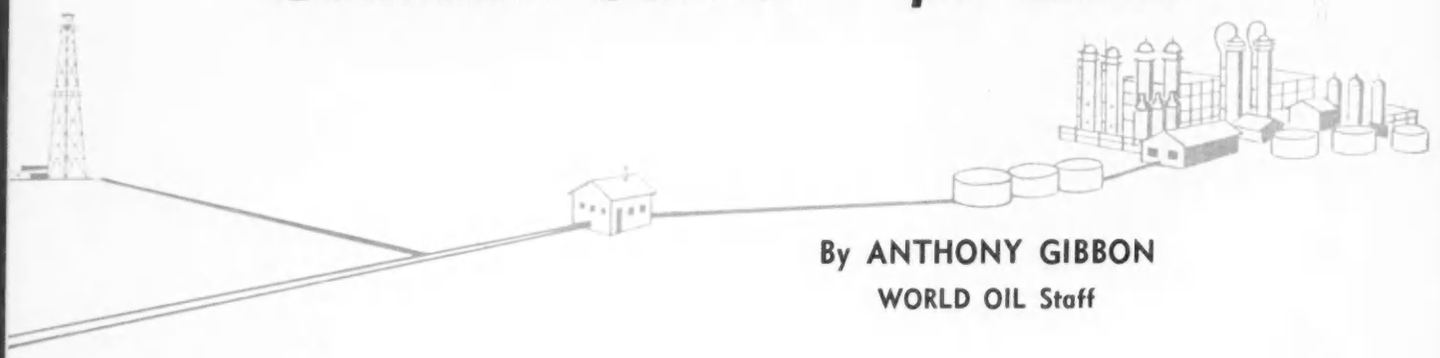
# Functions of Common Carrier Pipe Lines



By ANTHONY GIBBON
WORLD OIL Staff

TO MOST people, the term "common carrier" immediately calls to mind the railroads. This is because the railroads are the most familiar example of common carrier operations, and all that the term implies in the way of public responsibilty, public service and regulation.

However, most of the major crude oil pipe lines of the nation are also true common carriers not only by legislation and court interpretation, but by the very nature of their operations and administration. Though differing in some essential respects, the regulatory authority exercised over the crude pipe lines by the federal government and the various states is similar, both in its basic principles and its application, to the regulations which are applied to the railroads today.

The basic of regulation of all types of common carriers is found in the English common law concept of common carriers as those persons who are engaged in the transportation of persons or property from place to place for the general public for compensation.

The distinctive characteristic of a common carrier under this concept is that he undertakes to transport for all people impartially and hence is regarded, in some respects, as a public servant. He is distinguished from a private carrier by his obligation to carry for the public generally, and by the higher degree of responsibility imposed on him for loss or injury to persons or property transported.

A glance at the history of the nation's crude oil pipe line industry will show how the pipe lines came to be considered common carriers, and how their regulation as such by federal and state governments developed.

Transportation of crude became a problem immediately after the completion of the Drake well in Pennsylvania in 1859. In the hectic days that followed the Drake completion, wells were drilled in an area that was about 30 miles from the nearest railroad. Wagons and barges were used to transport this early production to railheads. Costs were high and the service was most uncertain.

Six years later, in 1865, Samuel Van Syckel built the first successful pressure pipe line for crude. About 80 barrels per hour could be pumped through its five miles of two-inch pipe. Other lines followed. And operators soon began transporting not only their own oil, but oil for other producers, giving a receipt for the shipment when tendered, and charging a fee for the transportation service.

Today, more than 80 years later, common carrier crude oil pipe lines still perform this same basic service —the transportation of oil from well to destination for all shippers on an impartial basis, for a reasonable fee.

Crude pipe lines today perform two essential services for the industry-gathering and transporting. In gathering, oil is taken from the various lease tanks located at or near the wells in a field. The lease tanks are owned by the producers or operators of the wells. The oil in the tank is gauged by representatives of the producers or operators and the pipe line company. When the gauging of the oil has been completed, the discharge valve is opened and the oil enters the gathering system. At this point it becomes the responsibility of the pipe line company, which brings the oil from the lease tanks together at some central point. From there it may enter a trunk line for transportation to some distant point; or it may be loaded aboard railroad tank cars, barges, or trucks for further shipment.

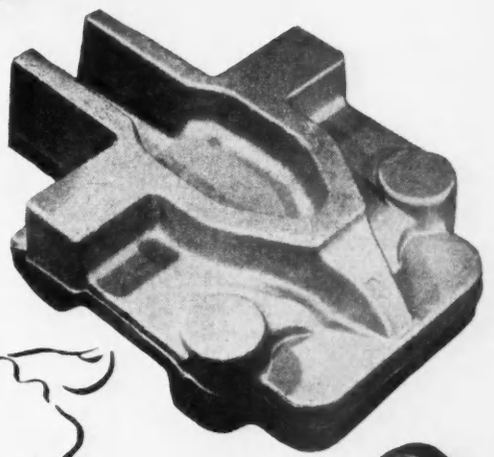
In the gauging operation at the lease tank, it is extremely important that the representatives of the pipe line company and the operator agree on the quantity of oil received by the pipe line, since this measurement is used as the basis for payments for the oil to the lease owner and operator by the purchaser, and for determining the amount of oil gathered and transported by the pipe line company.

In performing its transportation function, a pipe line company accepts the oil at a definite point of origin and transports it to a fixed destination. Points of origin for an individual company may be a gathering system, a connection with another company's lines, a barge or tanker terminal or other place for receiving crude in quantity. Principal destinations include refineries, connections with other pipe lines, and connections with other forms of transportation.

In these common carrier operations, the pipe line company acts solely as a transporter of the crude. Pipe line companies do not buy and sell the oil they transport. The oil in transit be-

**CRUDE OIL and products pipe lines are performing a specialized function vital to the petroleum industry and to the public. They transport one-eighth of the total freight moved in the U. S. today. They are performing their highly essential service with efficiency and economy unmatched by other forms of land transportation, although problems have been raised for them by increased government regulation. This discussion brings out specifically what services the pipe lines perform; where their responsibilities begin and end; and what laws and regulations control their operations.**

# When it comes to Drop Forgings, we're YES-MEN!



**W**hat we mean is, we can say "**yes**" to so many important questions about our drop-forging service. For instance:

Does Bethlehem make the steel for all its forgings? . . . **YES!**
(It's part of our complete integration.)

Does Bethlehem make the dies? . . . **YES!**
(Precision work to your specifications.)

Does Bethlehem have extensive forging equipment? . . . **YES!**
(Steam hammers, board hammers, mechanical presses and upsetters.)

Heat-treating? . . . **YES!**
(Complete, modern equipment all the way.)

Does Bethlehem produce a large number of weights and designs? . . . **YES!**
(Two yeses, here. Weights from 1½ to 250 lb; an unlimited range of designs.)

How about Bethlehem's experience? Extensive? . . . **YES!**
(We're old hands at the business. Been at it for years and years, serving many different industries.)

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

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longs to the shipper, who may be the producer or the purchaser.

They accept the oil from the shipper in the same manner as a railroad accepts a shipment of freight, and usually are required to deliver a like quantity of oil of the same grade and quality at the specified destination. Charges for this service, and the conditions of shipment to be observed by carrier and shipper, are set by the tariffs. The tariffs, in turn, are subject to approval of the regulatory agency of the federal or state government concerned—the Interstate Commerce Commission in the case of interstate shipments, the state agency in the case of intrastate shipments.

In performing these important functions, and performing them more economically and efficiently than any other form of land transportation, the pipe lines have developed into a large and highly-specialized industry consisting of numerous competitive companies.

Van Syckel's original five miles of two-inch pipe have grown to more than 150,000 miles of pipe ranging in diameter up to 30-inch. The oil lines transport one-eighth of the total freight being moved in the U. S. today.

Modern, large diameter lines have been found to be far more efficient and economical than the multiple lines of smaller diameter which were common before facilities for moving and laying the big pipe were developed.

Concurrently with this development of the pipe line industry has come development of governmental regulation of the industry.

Using as their basis the common law concept of common carriers, the state legislatures were the first to impose statutory restrictions and limitations on various types of common carriers. However, with the development of the railroads, these early acts were found to be unsatisfactory for regulating carriers whose lines extended across many states.

The result was the Interstate Commerce Act, passed in 1887. The act sought to secure just and reasonable charges; to prohibit unjust discrimination; to prevent undue and unreasonable preferences to persons, corporations or localities; and to abolish combinations for the pooling of freight. It did not cover pipe lines.

Courts of law, however, soon began to detect signs of close similarity between pipe line operators transporting for other people, and common carriers as defined under traditional concepts of law. Once this occurred, it was a natural step for Congress and the state legislatures to enact laws regulating the pipe lines as common carriers.

These efforts were climaxed in 1906 by the passage of the Hepburn Act, which declared interstate oil pipe line companies to be common carriers, and subject to regulation by the Interstate Commerce Commission.

Most pipe line companies resisted being designated as common carriers and the resulting litigation ended with a Supreme Court decision in June, 1914, in *The Pipe Line Cases,* 234 U. S. 548. The action started in 1912 when the Interstate Commerce Commission, under the provisions of the Hepburn Act, ordered most of the nation's pipe line companies to file tariffs showing rates charged for transportation services.

In an opinion holding against the pipe lines, Justice Oliver Wendell Holmes said that inasmuch as these lines were carrying "everybody's oil to market," they were in fact and in law common carriers. The decision made it plain that a pipe line moving substantial quantities of oil in interstate commerce, which oil is produced from wells owned by a variety of persons, is covered by the Interstate Commerce Act even though the carrier requires the producer to sell the oil at the wells.

Fortunately, the federal government has recognized some of the basic differences between pipe line and railroad operations in applying regulations. Where railroads carry a variety of cargo in many directions, pipe lines are limited to one cargo and to one direction of movement. And where other common carriers and public utilities are normally afforded some protection against competition, the pipe lines neither desire nor receive the exclusive or limited franchise which usually goes along with such regulation.

Hence, though the pipe lines are subject to tariff and valuation provisions of the Interstate Commerce Act, they are not subject to certain other restrictions such as the commodities clause and the requirement of a Certificate of Convenience and Necessity before undertaking construction or abandonment.

More recently, however, the pipe lines have become subject to another form of regulation by another branch of the federal government. This is regulation by the Department of Justice, and results from suits brought by the federal government under the Elkins Act against most of the nation's oil pipe lines and their corporate owners.

Passed in 1903, the Elkins Act was designed to strengthen the anti-discrimination and anti-rebate provisions of the Interstate Commerce Act. The Department of Justice, in 1940, charged that dividends paid by pipe line companies to their shipper-owners were actually rebates. Under the Elkins Act, penalties amounting to three times the dividends paid could be sought.

The cases were settled in 1941 by an agreed judgment under which no penalties were exacted but by which annual dividends paid by pipe lines to their shipper-owners are limited to seven percent of the pipe line's Interstate Commerce Commission valuation.

Since the two decades prior to the Consent Decree were marked by a steady downward revision of pipe line tariffs, the effects of the decision on tariffs were not profound; and pipe line rates have not declined substantially after the decree was entered. The provisions of the decree are complex and, in many ways, obscure. As a result of it there is regulation of the pipe lines by two independently functioning branches of the federal government.

The regulations outlined apply to most of the nation's crude oil pipe line companies, and to those companies which operate products lines as common carriers.

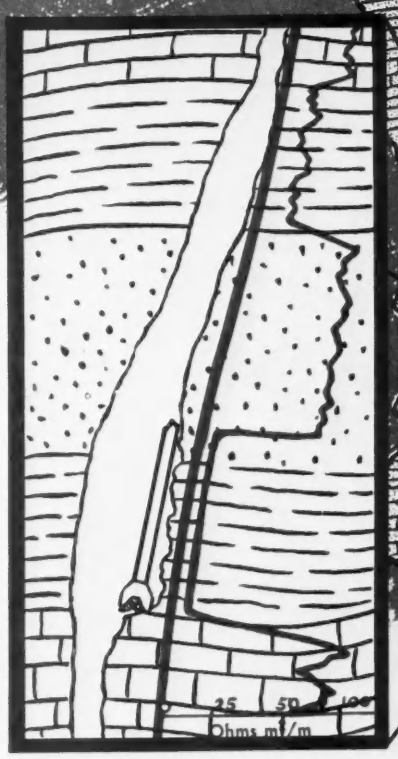
Natural gas pipe lines, however, are subject to entirely separate regulatory authority under the Natural Gas Act, 15 U. S. C. 717, as administered by the Federal Power Commission. Their regulation, including the fixing of rates and valuation, is quite different from that of common carrier crude and products lines.

Crude oil pipe line companies may follow any one of several patterns of organization and ownership. Some are independently owned and operated and are not affiliated with another oil company. Others are separate companies which are owned wholly or in part by an integrated oil company. Others are operated as departments of an integrated company. A fourth type includes independent companies which have entered into a contractual, operating agreement with any of the other three types of pipe line companies mentioned.

In most cases, the integrated lines, because they form a part of a larger and broader operation, possess certain distinct advantages from which they, the oil industry as a whole, and, in the final analysis, the general pub-

■ CONTINUED ON PAGE 70

# LOCATE "FISH" WITH THE SCHLUMBERGER ELECTRICAL LOG




## MANY OPERATORS USE THE SCHLUMBERGER ELECTRICAL LOG AS AN AID IN DETERMINING THE DEPTH AT WHICH A "FISH" IS LODGED

Because the electrical resistivity of steel is many times less than that of the ground, anomalies on the electrical log caused by lost drill collars, joints of drill pipe, and parted casing are very definite. It is possible to save many hours on a fishing operation by appropriate use of the Schlumberger Electrical Log.

The next time you are faced with a fishing operation, call your Schlumberger Engineer.

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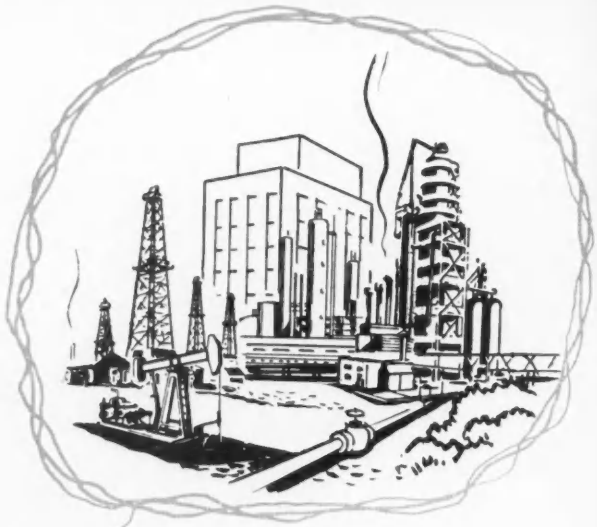
# Your Company Magazines



**WE ARE THE THREAD WHICH SEWS ALL THE PIECES TOGETHER.**

***—Mrs. Charlotte A. Woodside, Editor, The Pioneer, a Benedum-Trees publication.***

**By AL REESE, WORLD OIL Staff**

THESE are your company magazines.

They are newsy without being nosy and instructive without being pedantic. They lead but never scold and advise but never sermonize. To the man afield they are a letter from home, and to the man at the desk a bright little journey.

Nearly every sizable oil company has one because management realizes that the dispersion of personnel and variety of interests peculiar to the industry create a need for a humanizing, bonding influence.

Whatever happened to Joe Smith? Who won the company beauty contest? What's this new pension plan all about?

Many thousands of employes are finding the answers inside their company magazines. The answers may be in simple, homey style or they may sparkle with crisp writing and careful editing. They may beg a glance from a page starkly black and white or they may shout from a gay wedding of words and art.

Circulationwise, they contrast in size as in format. A WORLD OIL questionnaire to 28 representative oil company house organs with a combined circulation of 1,068,070 came back with the information that the press runs range from 800 for *The Tour,* published by The Shamrock Oil & Gas Corporation, Amarillo, Texas, to 316,000 for *The Lamp,* published by Standard Oil Company (N. J.).

Usually, the circulation of the magazine does not indicate the size of the company, but rather the audience to which it is appealing. *The Tour,* for instance, is a name-and-picture monthly seasoned for employe consumption, whereas *The Lamp* is a handsome quarterly for stockholders, employes, and the general public. To round out its company's publication program, *The Tour* has a big brother, *The Shamrock,* which each month takes feature stories to 8200 customers and potential customers.

The effort to reach the entire desired audience through multiple publications of widely differing format and content is exemplified by Shell Oil Company. Shell's house organ is *Shell News,* a news-feature monthly which goes to the homes of 35,000 employes. With its soberly attractive layouts, solid features and scattering of news and pictures, the *News* is as satisfying as a thick steak—medium done and easy on that fancy sauce. But the Shell family is large and with an appetite to size, so 22 local payroll centers also have periodicals. These are generally in modified newspaper format and emphasize local news and personalities of interest to the area.

Sun Oil Company uses a comparable plan. The company publishes four monthly newspapers in addition to *Our Sun,* a quarterly with a circulation of 22,000 which goes to employes, stockholders, some royalty holders, community leaders and libraries.

The Texas Company has another approach to the heterogenous audience. *The Texaco Star* (circulation 128,000) and *Texaco Topics* (circulation 37,000) are so similar that the casual reader might wonder at the reason for two magazines. However, there are real differences which are dictated by the tastes of their selected readership. *The Star* goes to both stockholders and employes and *Topics* goes only to employes. *The Star's* cover is a splash of color, its content heavy with well-displayed features not necessarily dealing with company affairs. Between *Topics'* black-and-white covers are fewer features and more folksy doings. It's the same girl, really, but the rouge

has been removed, the silk dress shucked off in favor of gingham, and the demure language has given away to sprightly small talk.

Standard Oil Company of California's *Bulletin* and *The Standard Oiler* are another effective team. *The Bulletin,* a spectacular triumph of the graphic arts, is a quarterly with a circulation of 125,000, most of them stockholders. *The Oiler* is heavy with company personalities and is sent monthly to 30,000 employes.

In contrast to the technique of slanting one of several publications at a single group, or a few groups, The Carter Oil Company's principal magazine, *The Link,* takes a scattergun blast at a variegated audience. It covers all phases of exploration, drilling, production, manufacturing and marketing and goes to 2600 employes plus more than 10,000 newspaper editors, farm agents, educators and business and civic leaders in 24 states. The employes' craving for additional personal news is satisfied by *The Carter News.*

### Sunray Typical

If oil company editors are publishing exactly the type of material they would offer if not chafed by a budget or space limitations, then *The Sunray News* is to this extent the ideal company magazine. WORLD OIL's questionnaire asked the editors for a percentage breakdown of their magazines' contents and the composite result as to type of material was more nearly mirrored by *The Sunray News.*

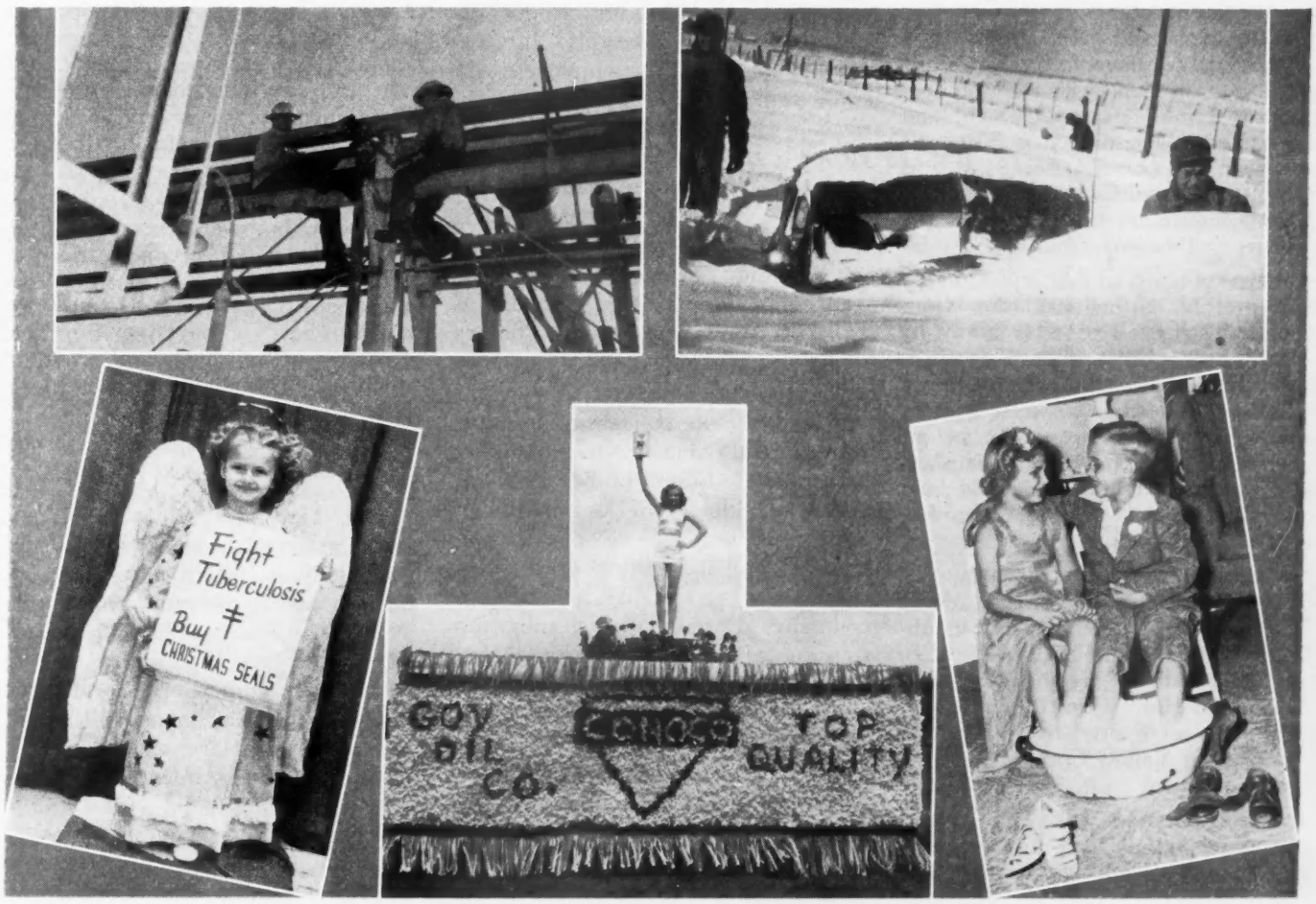
The average content of the magazines surveyed is as follows:

| | |
|---|---|
| Company news and personalities | 31.0% |
| Features on company activities, accomplishments and installations | 22.2% |
| Related features (like trucks, planes, others using industry products) | 15.3% |
| Features on company people | 8.0% |
| News related to industry | 5.0% |
| Related picture features | 6.3% |
| Safety features | 4.2% |
| Company policy features (like those explaining pensions) | 3.4% |
| Completely unrelated features | 2.9% |
| Messages from company executives | 1.2% |
| Unrelated pictures | .5% |

This percentagewise breakdown was set up to describe in general the average content of the magazines and does not mean that a rigid schedule is followed by the editors, most of whom indicated that they use the procedure of the old-fashioned cook: a pinch of this and a dash of that. As explained by William M. Craig, managing editor of *The Lamp,* "We don't consciously make up our issue of *The Lamp* in terms of percentages of space. To achieve variety and pacing we do try to include in each issue articles on foreign operations, domestic operations, products, scientific developments and people. This is a very flexible arrangement and may vary considerably from issue to issue."

To which C. R. Olson, editor-in-chief of *Lion Oil News,* adds: "... no set formula as to percentage of this and that, merely a careful screening of content of each issue preparatory to starting work—with an eye to balance."

More patternized than average but still far from rigid is the publication plan of *The Humble Way,* house organ of Humble Oil & Refining Company and Humble Pipe Line Company, which goes bimonthly to 40,000 employes, stockholders, newspaper editors, educators, industrialists and some royalty owners. Walter Beach, editorial supervisor of publications for Humble, revealed that *The Way* employs a budget sheet which provides a clearcut pattern over a long period, though not strictly followed in each issue. The




***The home . . . the job . . . the community***

**Photos used in *Philnews, The Pioneer, The Sunray News, The Orange Disc and The Red Triangle.***

budget calls for stories on production, employe relations, the state of Texas, oil in general, refining, transportation, exploration, financial matters, gas, marketing, research and products. Most space is devoted to production (drilling, producing, new methods, techniques), 19.5 percent; and next is employe relations (plans, promotions, safety, annuitants), 14.9 percent.

### No Sounding Boards

Disclosure by the questionnaire that an average of only 1.2 percent of material is devoted to messages from company executives is powerful evidence that the magazines are no mouthpieces of management but are truly for and by employes. O. C. Irvine, editor of *United Gas Log,* spoke the minds of most in explaining: "Messages from company executives are seldom used, this because of the management's wishes that they not be pushed to the forefront in the employe magazine. They insist they are employes of the companies like everybody else and definitely want to be treated as such."

Feature material not directly related to the industry, another low-percentage item, is stoutly supported by a minority group of editors. (Only 12 use this sort of material.) One of the minority is D. C. White, editor of *The Orange Disc,* published by Gulf Oil Corporation. He explained: "An article featuring a section of the country, for example, in our opinion, helps sell America, creates a more favorable political climate for the industry, builds good will for the sponsoring company, and last but not least, helps create sales by stimulating motor travel to see the country and the attractions described."

A type of material that is persistently and prettily batting its lashes from once hairy-chested pages is stories by women and about women. The once-held theory that any reader's heart could be bracketed between a story about his job and a picture of his dimpled daughter has been modernized by the realization that women can hold oil company jobs—and stock, too. Result: women's editors.

Among the several magazines so equipped is Editor Robert L. Hazlett's *The Beacon,* a neighborly, newsy publication of The Ohio Oil Company. In a feature called "Femininely Speaking," Ruth Haley gives the customers such items as: "Corn Bread Ring . . . 1 cup Quaker Yellow Corn Meal . . . 1 cup . . ."

Editor Rex Maus' spry *The Expanding Circle,* published by Arkansas Natural Gas Corporation, has a feature, "Milady Arkansas," edited by Nina Jane Nash, former model at Dallas' Neiman-Marcus.

That more magazines don't fall in step may be due to the three-ply shackle of time, space and the budget. When asked about the division of duties on *The Pioneer's* staff, Editor Woodside mourned: "The one full-time employe is me . . ."

Less lonely are most of the editors, though the size of the average staff is not determinable because of man hours divided between companion publications or other activities. One example is *The Humble Way* staff. It consists of a supervisor who plans editorial content, works with artists, and supervises four other publications; a senior publications assistant who divides his time between writing and other editorial tasks; a junior publications assistant who is writer, layout man and production man; two junior publications assistants who double on other publications, do press release work and prepare pamphlets; two photographers; and a lab assistant and negative and picture file girl. (The photographic setup also serves other company publications, advertising, sales promotion and movies.) Six or seven free-lance artists are used on assignment.

*The Shell News* staff, headed by W. M. Upchurch, Jr., manager of the Employe Publications department, includes an assistant manager, five writers, and a clerical and production staff of six girls who also prepare various materials for employes. Art work and magazine layouts are supplied by an art director and staff attached to the Public Relations department. Photographs are made by both Shell and commercial photographers.

*The Lamp* has a staff of nine, including the editor, managing editor, associate editor, three writers, a circulation assistant, secretary and typist. Photography and art work are by assignment to free lancers.

A staff of more typical size produces *The Sunray News,* a 24-page monthly for employes. Editor Luther Williams and Managing Editor Jack E. Brown are responsible for the task of gathering material and for editing stories contributed by correspondents from each company district. Photographs are staff made; art work is by free lancers.

Asked to outline the editorial purpose of their publications, the editors issued replies that were ably summed up by T. D. Collett of *On Tour,* published by Union Oil Company of California:

> ". . . our publication is trying to be an accurate, dependable, convenient medium of two-way communication; a record of everything worthwhile that is being thought, planned and accomplished throughout the company; a means of recognizing and honoring outstanding performance on the parts of individuals and groups; a factual substitute for the inaccurate grapevine; a bridge for the gap between management and employes of a large corporation; a patron of safety, intelligence, progress, high skills, good workmanship, conscientiousness, honesty, industry; and an instrument for promoting intelligent human relations. We undoubtedly fall short of the mark, but our aim is high."

## *Common Carrier Lines*

■ CONTINUED FROM PAGE 66

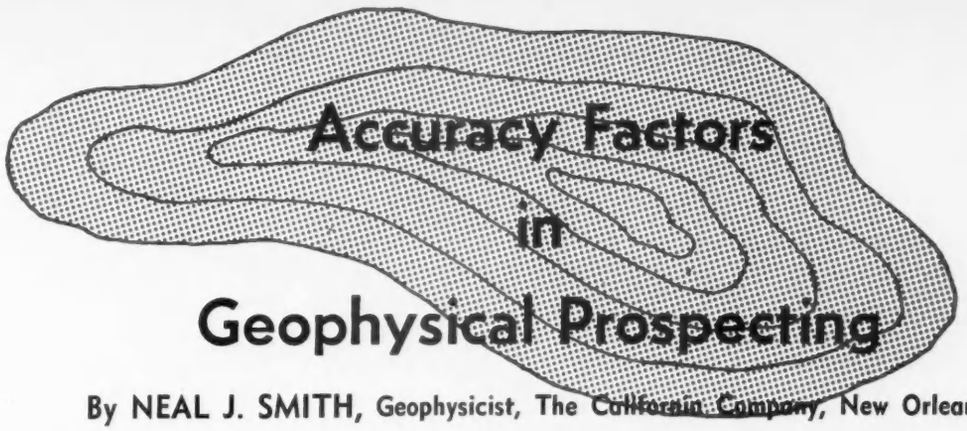
lic, realize substantial savings on transportation.

Integrated pipe line companies have access to essential geological and economic information and to other important advisory services without unnecessary and costly duplication of effort, where the independent organization has to provide these services at additional costs. The integrated pipe line companies obtain from other members of their corporate family needed data concerning production rates, reserves and anticipated life of oil fields where pipe line service is being considered. Also available to the integrated pipe line is vital information concerning present and future requirements of the refinery or refineries which its lines serve.

Assurances of oil supply and an outlet permit an integrated pipe line company to construct a new line earlier and with more provision for anticipated increases in production than an independent, non-affiliated company could afford to do with risk capital from outside sources.

Construction of a modern pipe line at today's prices requires large amounts of capital, and an integrated company can obtain this capital in greater amounts and at lower interest rates than can an independent company whose investors must rely solely on limited pipe line earnings to protect their investment.

Regardless of their organization and ownership, however, the crude pipe lines of the nation are performing a specialized function vital to the petroleum industry and to a vast consumer public. They are performing their function with efficiency and economy which are unmatched by other forms of land transportation.




*Part 2*

**(CONCLUSION)**

By NEAL J. SMITH, Geophysicist, The California Company, New Orleans

THERE is almost invariably at the surface a comparatively thin layer in which seismic waves have a much lower velocity than in the material beneath. It is commonly called the weathered layer, although it has only a qualitative relationship to the strictly geological weathered layer. The problems imposed by this layer are extremely important in seismic work. For instance, as the diagram (see Figure 4, April WORLD OIL) suggests, it is necessary to drill through it in the usual case so that the explosion can be set up at the base or slightly below. Also, it is the weathered layer which is responsible for the refraction breaks, or so-called "first breaks" seen on the typical record. These represent the arrival of energy which has traveled first along the base of the low velocity with the velocity of the higher speed material beneath it and then, by refraction, sharply upward into the seismometers at the surface. These refraction breaks are extremely valuable in the correction of reflections for weathering irregularities.

It was earlier suggested that the reflection method is quantitative with respect to mapping structure. That is probably not true in the sense that an engineer would prefer to use the term. The relative accuracy of the method—the extent to which it is quantitative—is a function dependent upon the validity of a number of necessary assumptions, and upon several types of variables. Some of these things can be controlled, some can be controlled in part, and some are presently beyond our powers to modify. The influential factors can be conveniently grouped in five categories.

1. The response of the area.
2. Available knowledge in the area both geological and geophysical.
3. Quality of the instruments used and the quality and experience of personnel on the job.
4. Field effort.
5. Interpretive effort.

Category 1, the basic response of the area, i.e., response to highest caliber present-day attack, plays a passive but important part. If no reflections can be obtained, or if none can be recognized, or if they are returned from the wrong part of the section, the effective "accuracy" is zero. At the other end of the scale are those regions from which good reflections are obtained from every pertinent level. All variations can exist between these extremes, and sometimes the lateral gradation is remarkably sharp.

### Lack of Response

Figure 5 illustrates this last point for a part of off-shore Louisiana. The records show respectively zero response and fair response in areas only a few miles apart. The amplification of the input signal was from 10 to 50 times higher on the "dead" upper record than on the usable lower one.

It should be pointed out that lack of response is, in itself, not always a bad feature. When it is on a local basis it may indicate faulting, or the crest of a sharply folded, or highly faulted structure. Even in these cases, however, it would be preferable if the evidence were positive.

Figure 6 illustrates another aspect of area response, the case of multiple reflection. Here the trouble is too much reflection from too shallow a source. The general explanation is that this occurs where two or more highly efficient reflecting layers are present which intercept the bulk of the available seismic energy and reflect it back and forth in a series of reverberations. Such a process is relative and, of course, most serious when the source is shallow since it then either blanks out or confuses the deeper data. The example is extreme. Reverberations continued out as far as the record was cranked. So far no solution has been found whereby such effects can be by-passed or mitigated.

Figure 7 shows still another aspect of area response. This is an example of differential natural filtering due to variation in the weathered layer. This is what is called a dual record because the top 12 traces and the bottom 12 record the receipt of the same energy but subject the energy to different amounts and kinds of filtering prior to recording. The upper half of this record was subjected to less filtering than the lower half in the lower frequency range.

Notice that the lower half of the upper record, and to a lesser extent the lower half of the lower record, contains a high proportion of low frequency energy. The record was shot in Mississippi. The seismometers feeding the lower portion of the record lay across an area in which the low velocity layer thickened abruptly. Not only was it thicker on this side, but its velocity was somewhat less. The presence of variable low velocity thicknesses across a record naturally contributes to the difficulty of the interpretation and to the quality of the result. It may occasionally completely mask the presence of reflections on the record.

Category 2 considers the influence on the accuracy of the seismic picture of the state of knowledge, or it might be better to say, the stage of exploration development of the region. If the geologist has an accumulation of subsurface information and if he communicates this to the seismologist, the validity of the interpretation will be proportionately increased. This fact does not seem to be recognized completely because there are some who virtually force the geophysicist and the geologist to work separately, as though the exploration game were a sport in which collaboration should be considered cheating.

Geophysical data with which the seismologist should be supplied would include, of course, any previous geophysical work done in the area. But what he would like most is information on the velocity with which sound waves travel through the rocks of the area. Obviously, if he is going to be

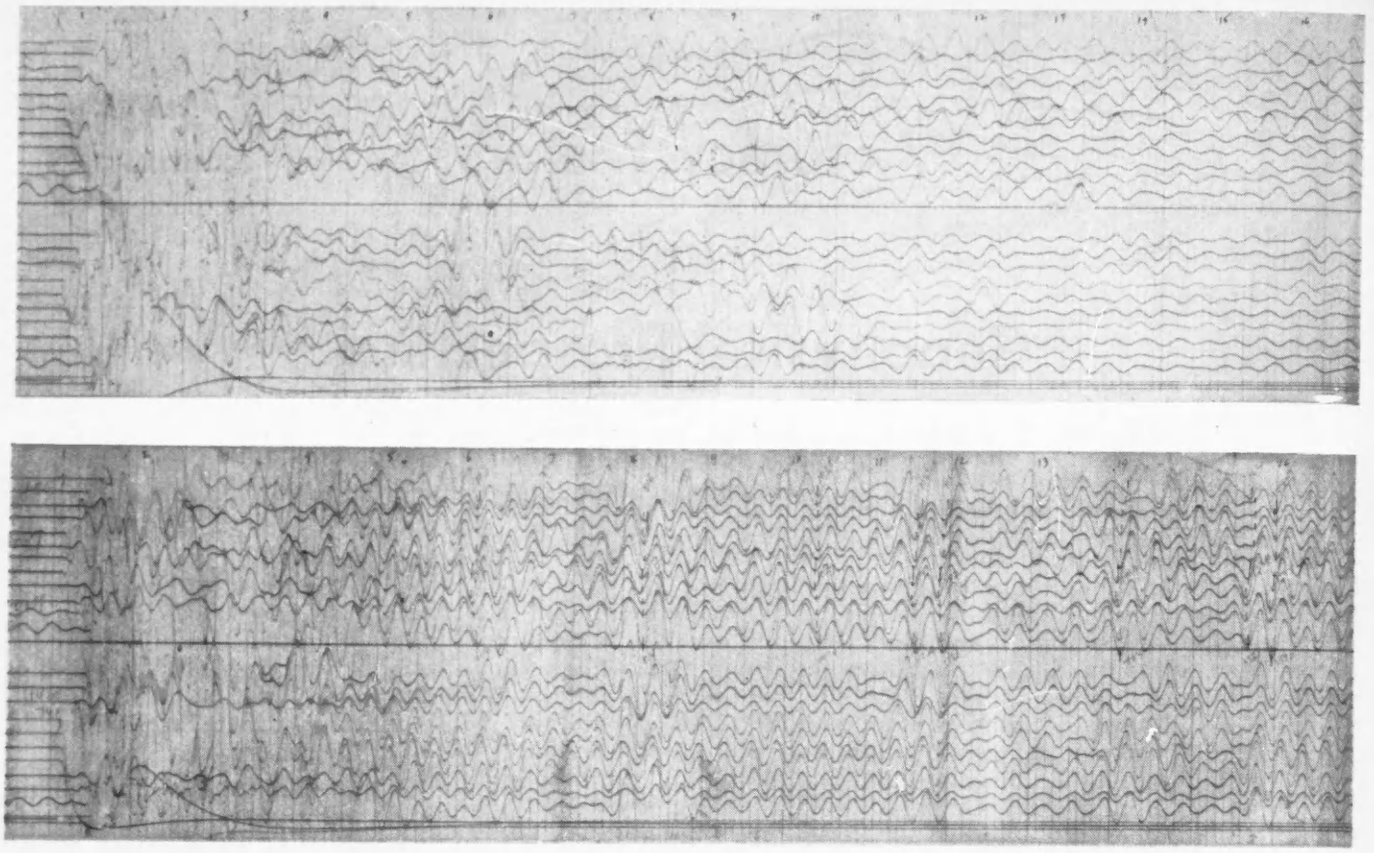


FIGURE 5. The effect of area response on the seismic method is shown here. The lower record is from a fair response area, while the upper record is from a zero response area. These areas are four miles apart in the offshore region of the Louisiana coast.

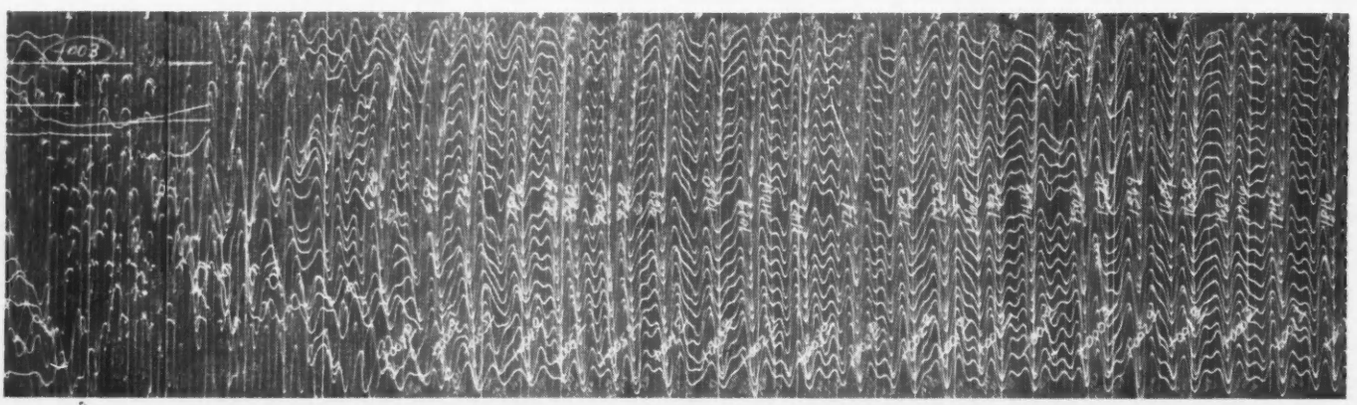


FIGURE 6. This illustrates the effect of area response on the seismic method with multiple reflections.

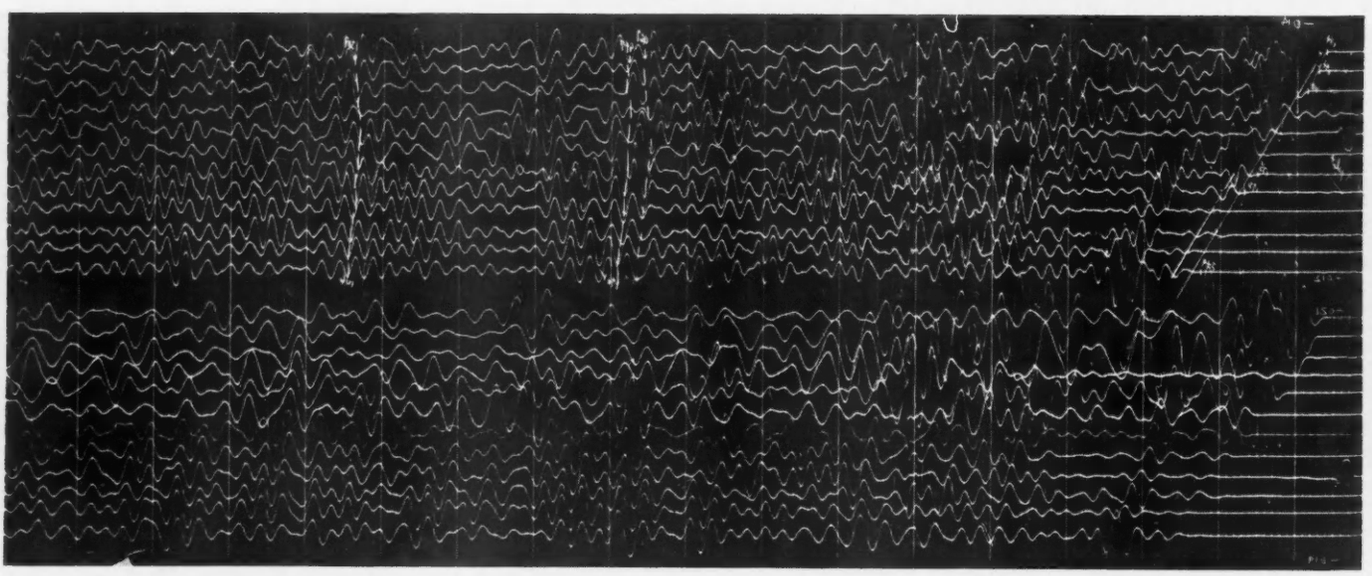


FIGURE 7. The effect of area response on the seismic method due to irregular weathering and differential natural filtering across the record.

able to convert time into distance and dip, he must know the velocity and, the more exactly he knows it, the more accurate the results will be.

The diagram on the left in Figure 8 illustrates the configuration of a wave-front in a semi-infinite, isotropic medium, the point of origin being in the surface. At successive instants the envelopes are hemispheres. The ray paths will be straight lines radial about the shot point. Situations as simple as this do not exist in nature, at least for the seismologist, although he may sometimes pretend they do.

In general, velocity increases with depth as a result of the influence of increasing age and pressure in that direction (Figure 8b). This relationship of velocity to depth can often be expressed closely enough for a given area as a simple function, generally either linear or parabolic. These functions are useful for making up computation charts or curves and form a basis for extrapolations in depth and across areas from one point of velocity information to another. Because they are easy to handle there is always a temptation to take them as gospel, to extend their use beyond the proper range.

The prime source of velocity data is from velocity surveys made in the borehole—surveys made by lowering a special seismometer into the borehole to measure the direct travel time of a shock wave set up by explosions at the surface. It is against these actual measurements that the seismologist properly does his curve fitting, assuming of course that he has a nearby survey available. Very often the particular prospect may be far from a surveyed hole forcing him to make the best guess he can. Naturally, his assumptions will be simple in accordance with the few data he has.

Figure 9 is a wave front chart made up directly from a borehole velocity survey. Note how far removed it is from the smooth envelopes just shown. The figure represents only half the wave front section; the other side would be symmetrical about the vertical axis.

The reason for the lumpy character of the wave front chart is apparent from a glance at the survey data itself (Figure 10). The steplike curves indicate instantaneous velocities at the depths shown, called interval velocity. The more gentle curve is the average velocity down to a given depth. Note that interval velocities are quite irregular and that in some places they invert the supposed natural order of by showing local decreases in velocity with depth. The carrying of simplified velocity assumptions into an area as complex, velocity-wise as this, could hardly lead to anything but a confused and doubtful interpretation.

It so happens that velocity varies horizontally as well as vertically. Neglect of this can affect the shape and orientation of the mapped structure as well as the accuracy of the calculated depth.

For instance, an ignored or undetected variation in velocity in the horizontal may result in a distorted interpretation whereby a nose may be contoured as a closed structure, or, more seriously, permitting a closed

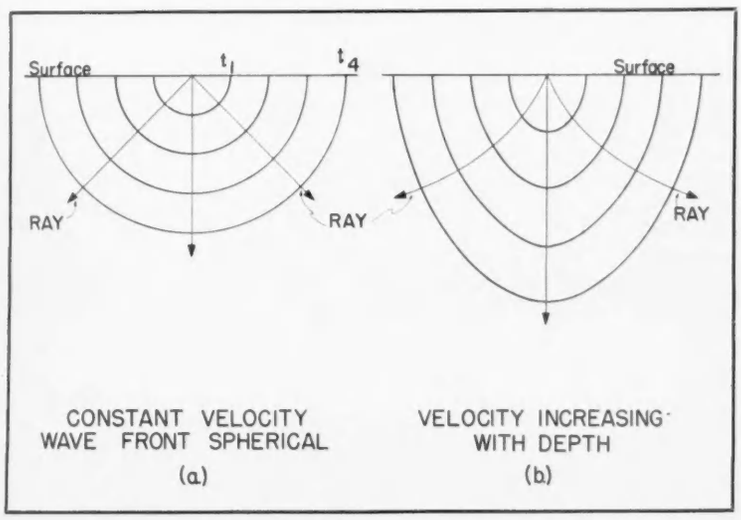



FIGURE 8. Simplified wave-front patterns.

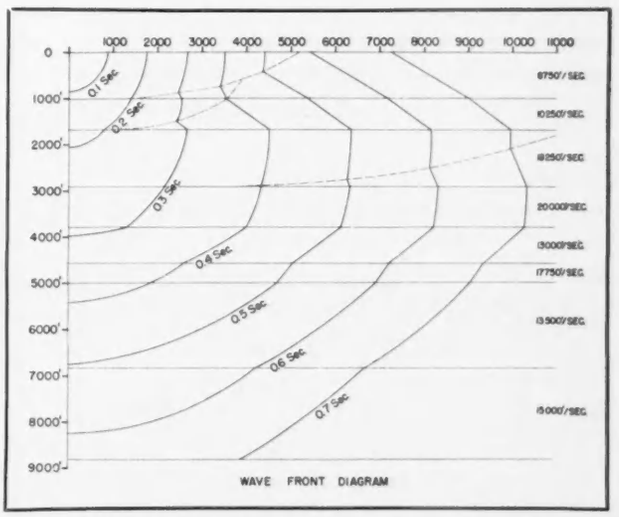



FIGURE 9. Wave-front chart from an actual case.

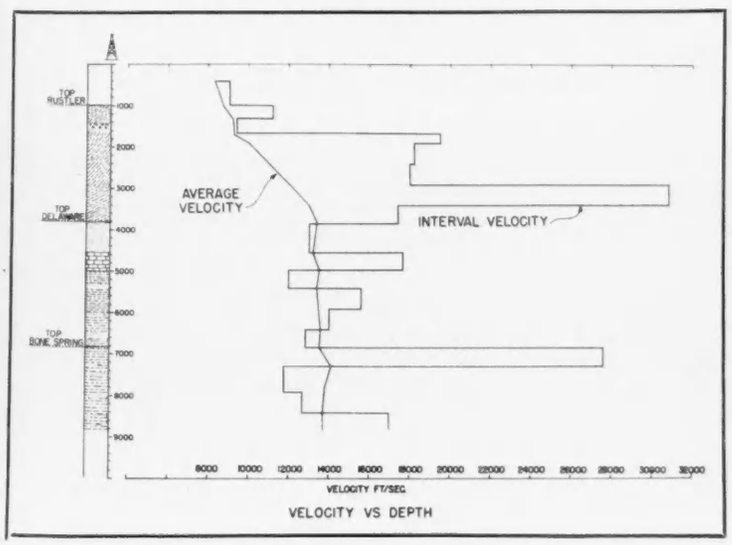



FIGURE 10. Velocity data from a bore hole velocity survey.

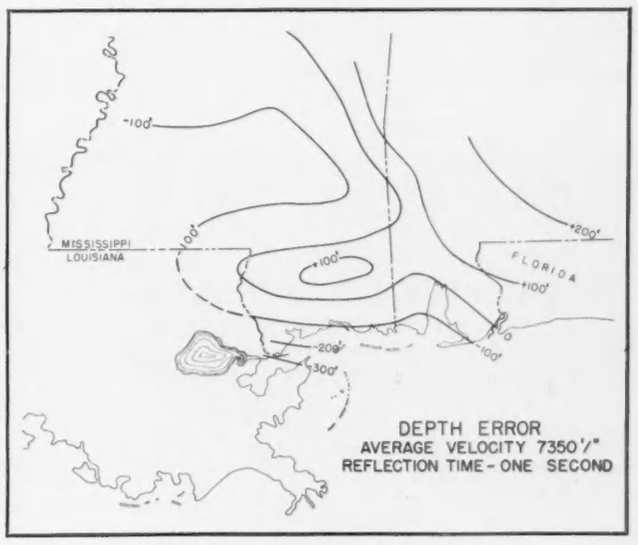



FIGURE 11. Velocity depth-error map.

structure to be contoured as a nose and hence neglected. Several such cases are widely known and many more, no doubt, are kept in the closet with the corporate skeleton.

Figure 11 can be called an error map. The contours indicate the approximate depth error which will result from the use of a constant velocity for reflections having travel times of about one second. The particular velocity of 7350 feet per second is corrcet as an average over the region for reflections of one second but, because the changes in velocity are progressive, it is proper to use it only along the zone indicated by the zero line. In Stone County, Mississippi, calculated depths would be 100 feet short. Over in Alabama, calculated depths would be short by 200 feet. Down toward New Orleans, the trend is the other way; computed depths would be 300 feet too deep.

So long as these effects are on a regional basis and so long as there are enough subsurface points to tie to, such changes won't be especially damaging. The tilt would not be noticeable on a local basis.

But the question is, "Do all the velocity variations fit the regional pattern?" The figure suggests that this is the case but it was prepared from scattered control. In many regions the few bits of velocity information often create a false impression of continuity and smoothness. As the amount of velocity control grows in an area it as not uncommon to discover that velocities may vary sharply within a small compass. Seismic surveys made in such areas which neglect these variations may be distorted to the point of uselessness, either indicating spurious structure or wiping out those that are interesting. For safety, it is impossible to have too much velocity control.

Category 3 deals with instruments and instrumentation or, perhaps more clearly, instruments and field technique.

Both instruments and the manner of their use are profoundly important as regards the quality of the result. This hardly needs statement. Nor is is surprising that instruments that are excellent in one region, as say in the marsh, may be poor to useless in another. The same goes for techniques. Personnel experienced in Rocky Mountain work may be helpless in Oklahoma. An experienced crew from Oklahoma may flounder for months in Mississippi. And almost any land-bred crew will look with shocked amazement on our practices in the marsh.

Examples of this classification can be found in everyone's files, although it is not always possible to separate the influence of technique and instruments. The most obvious examples are found in a comparison of earlier work in a particular prospect with the results of a later job. Here the laurels generally, but not always, fall to the latest indicating the improvement of both technique and instruments with passing time.

Figure 12 illustrates a simple but interesting point of technique which relates to shooting in water-covered or water-marsh areas. The two records were taken offshore from the Louisiana coast. The lower record is not usable. It was obtained from an explosion at a depth so great that the initial expansion of the gases did not tear the water surface but oscillated, or collapsed and expanded, as the envelope rose under buoyancy toward the surface.[4,5] Each such rhythmic collapse is equivalent to another, though weaker, explosion. The seismometers have picked up not only the primary burst but a second and a third. If the shot had been placed deeper, a fourth might have developed. Naturally, these following bursts obscure the record, not only as a result of the water borne energy arrivals directly from each collapse as shown by the particular example, but through the multiplicity of overlapping reflection events which these successive sound sources often induce on the lower portion of the record.

The question then arises as to which reflection belongs to which source. The preventive is to shoot shallow enough so that the primary expansion of the gas envelope formed

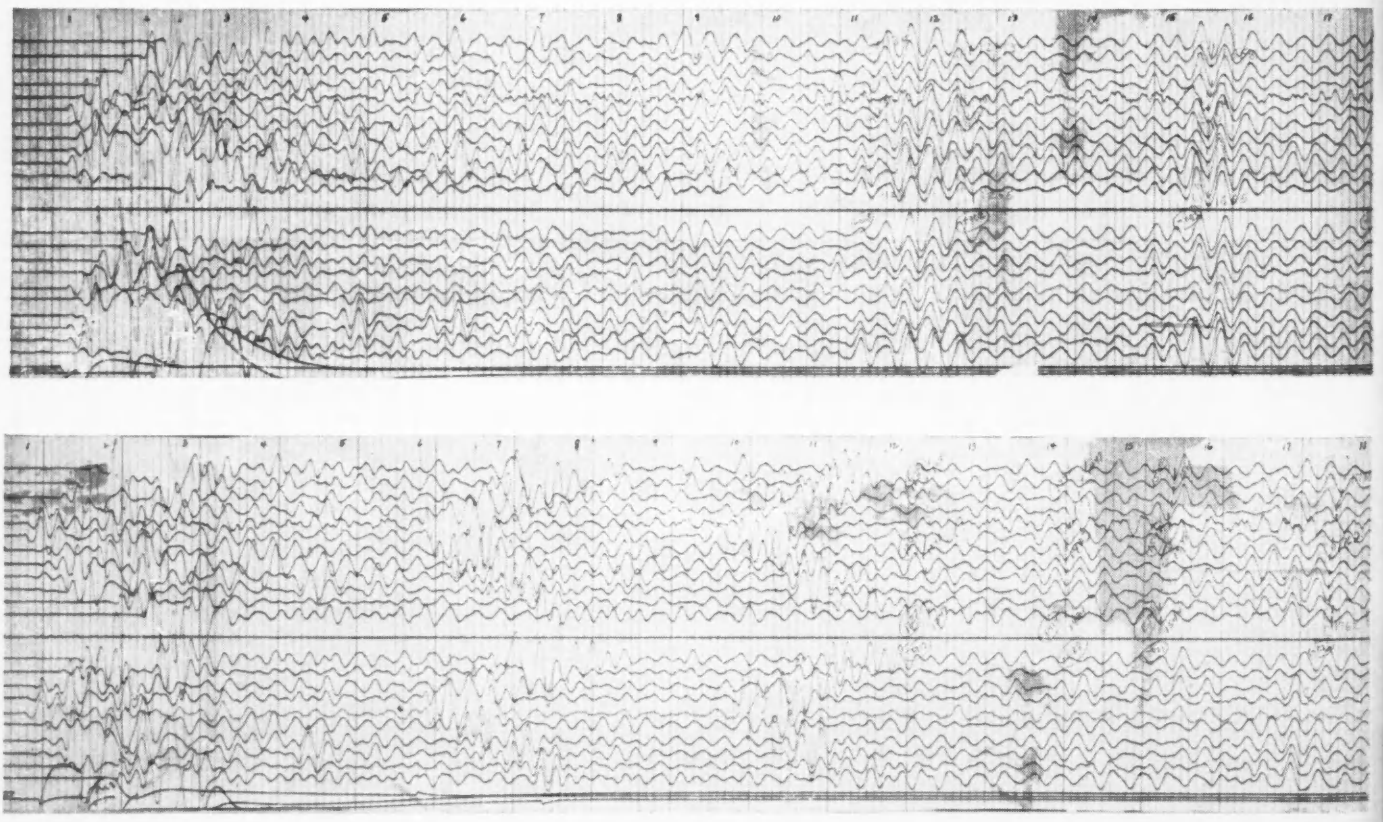


FIGURE 12. Effect of shooting technique in water-covered areas.

# Are you looking for Reefs?

## NORTH - CENTRAL (Texas) REEFS

The above sketch is an idealized conception of the general geologic features.

**Reefs in this general area occur both in the Pennsylvanian (Canyon) and in the Mississippian (Chappel). The former, so far, are more important and may attain a vertical thickness of more than one thousand feet, while the latter usually have a low relief. In either case, the reefs often have a broad lateral extent.**

**Oil production is normally found in the reef tops, and also in stray, draped sands above the reefs. Limestones draped over the reefs seldom produce. In some cases, these reefs are perhaps related to deeper structural features.**

**SSC Recommends the Following Approach For Seismic Reef Exploration**

No. 6 VELOCITY ANALYSES

Seismic velocity anomalies usually occur in the vicinity of organic reefs. Proper evaluation of these anomalies will minimize erroneous structural mapping. Furthermore, detailed velocity analyses may indicate the presence of reef structures. SSC emphasizes that VELOCITY ANALYSES are an essential part of a successful reef exploration program.

*(This is one of a series)*

**Seismograph Service Corporation**

TULSA, OKLAHOMA, U. S. A.

on detonation tears open the water surface releasing the gases before a collapse can occur. This is a happy circumstance since it fits conservation requirements. The upper record in the figure was obtained from a shallow shot in the same locality as the deeper; it is quite usable.

Category 4, field effort or density of data, is easy to understand. Obviously, the more data of a given quality obtained per unit area the more detailed and accurate the final picture will be.

Category 5, the influence of interpretive effort on the accuracy and dependability of the seismic picture, is also easy to appreciate. As an extreme example, Figure 13 illustrates a situation which old seismologists use to frighten the young ones. The odd part is that it does happen.

The figure shows a series of profiles across a steep-sided syncline. Each record receives reflections from both limbs of the syncline, which is possible if the reflector has sufficient curvature. An interpreter not experienced in steep dip work—for instance, one from the Gulf Coast—might plot the data from each shot point directly below that shot point as he would in low to moderate dip areas. But if he did, the dip segments would appear to show him a shallow syncline above an anticline. If he worried about the geologic probabilities, he would assume that the two were separated by a profound unconformity or might have been superimposed by thrust faulting.

The true picture is obtained by migrating the dip segments to their proper spacial positions.

### *Specific Accuracy*

Much has been said about those things which affect the accuracy of the seismic method but nothing as to what that accuracy might be in given circumstances. It should be fairly obvious that this is a difficult point to make.

When record quality is poor, when velocity control is lacking, when control is scattered, the seismologist will often consider himself fortunate if he can successfully determine the mere presence or absence of a structure without regard for such niceties as amount and area of closure, depth and so forth.

When record quality is good, when velocity control is adequate, when there is integration with subsurface geology, it is not uncommon to have the interpreter bracket depths to particular horizons within 50 feet and to have the drill prove him out.

With regard to relative position on a given structure he may do even better, provided his control is in sufficient detail. He can sometimes be made to indicate, after a little prodding perhaps, that one location can be expected to be, say 20 feet higher or lower than the next one, and he will be correct enough of the time to suggest him as a subject for inquisition on the next occasion. Not that anyone is particularly surprised, however great his disappointment, if such predictions fall wide of the mark. There is too much art, too much experience, perhaps too much hope in the process for absolute determination short of the drill.

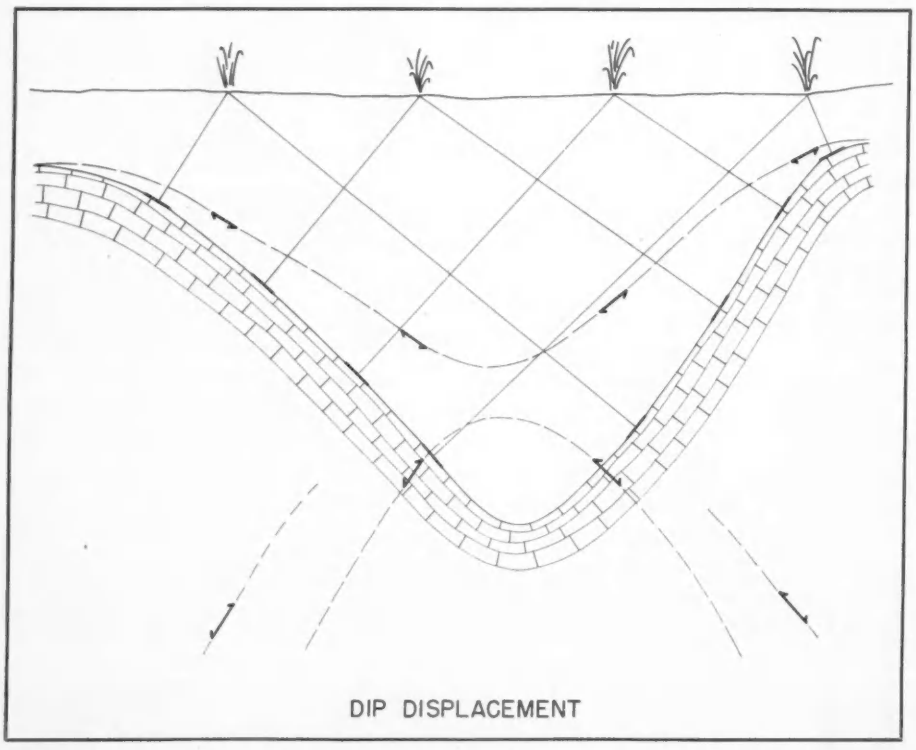



**FIGURE 13. The spurious anticline. This illustrates the need for proper location of reflecting points and dip segments.**

## *About the Author*

NEAL J. SMITH received his B.A. and M.A. degrees in geological sciences from the University of California in 1934 and 1936 respectively. Except for a few months in early 1936 with Shell Oil Company, he has been since graduation in the employ of either The California Company or The Standard Oil Company of Texas, as a coordinator of various types of geophysical prospecting, and as interpreter of the data with particular reference to gravity and seismic methods. In 1945 he was made superintendent of the Geophysical division of The California Company, and in 1949 he became geophysical consultant for The California Company, which position he presently holds.

### Summary

As between the three methods considered, the magnetic method, though fastest and cheapest, is the least definitive for petroleum exploration. The seismic method, though the slowest and most expensive, is the most precise and definitive, while gravity lies between the two but closer to the magnetic method than the seismic.

Within each method the accuracy or reliability in a particular case is a function of the amount of subsidiary and corollary geophysical and geological data available, of instrument quality, of the caliber of the personnel involved, and of the time allotted to the problem.

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[4] "Repeated P-Waves in Seismic Exploration of Water-Covered Areas," Roy L. Lay, Geophysics, Vol. X, No. 4, October, 1945.

[5] "Recent Results in Submarine Geophysics," by Maurice Ewing, G. P. Woollard, A. C. Vine, and J. L. Worzel, Bulletin of the Geological Society of America, Vol. 57, pp. 913-915, October, 1946.

**ACKNOWLEDGMENT**

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# Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

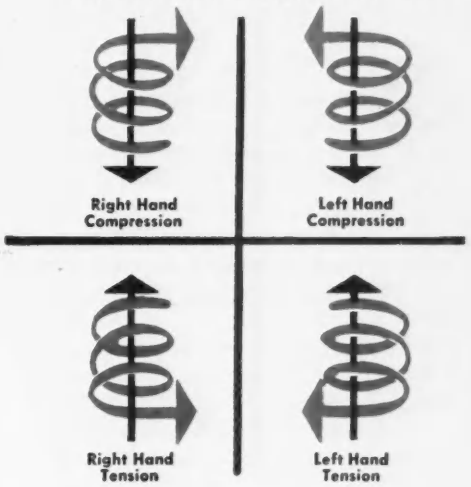
OUR 31st YEAR

*ANOTHER NEW BAASH-ROSS PRODUCT!*

## A simple, positive way to REMOVE STUCK TUBING STRINGS FROM YOUR PRODUCING WELLS

## BAASH-ROSS PRODUCTION SAFETY JOINTS

**4 TYPES TO MEET EVERY PRODUCTION REQUIREMENT**




Why run the risk of costly salvage operations every time stuck packers, sanding conditions or similar difficulties jeopardize recovery of your tubing string, when it costs so little to insure recovery by using Baash-Ross Production Safety Joints?

A Baash-Ross Production Safety Joint placed in your tubing string provides a positive means of freeing the string at the point where the Safety Joint is installed, thus permitting important savings to be made in production operations. For example . . .

**▶ Where production packers are used, a Safety Joint should be installed above the packer to permit positive and complete release of the tubing string should the packer become stuck.**

**▶ Where sanding conditions exist, one or more Baash-Ross Production Safety Joints should be installed in the tubing string to permit selective release and maximum recovery.**

**▶ Where it may be desirable to change production methods in a well, a Baash-Ross Production Safety Joint should be installed in the tubing string to permit such changes to be made quickly and easily without disturbing the packer.**

Baash-Ross Production Safety Joints are simple in design, positive in operation and low in cost. They are provided with a unique locking lug that permits heavy rotational loads to be transmitted through the Joint without loosening it—yet disengagement can be quickly made whenever desired by merely following a simple sequence of operations. A choice of *four* different releasing actions is available—either *left* or *right* hand rotation, combined with either *raising* or *lowering* the production string—thus providing the exact releasing action best suited to each production hook-up.

### LEAK-PROOF SEAL . . . FULL OPENING PASSAGE

**Note in the illustration how the Baash-Ross Production Safety Joint is packed off top and bottom with self-sealing "O" rings to permit circulation through the Joint without leakage. Also, the Joint is full-opening so that rods, tools and clean-out equipment can be passed without difficulty. In fact, the Joint has the same internal and external diameters as the production string itself. Anything that will pass through the tubing string will pass through the Joint . . . and the Joint itself will pass through anything the tubing couplings will pass through—an important consideration when used with certain types of suspensions.**

### A Size For Every Production Need

**Baash-Ross Production Safety Joints are made of heat-treated alloy steel and are available in all four releasing actions to fit all sizes and types of API Tubing. So no matter what the nature of your particular production operations, you can protect against costly recovery or conversion operations by placing one of these efficient Joints on every tubing string.**

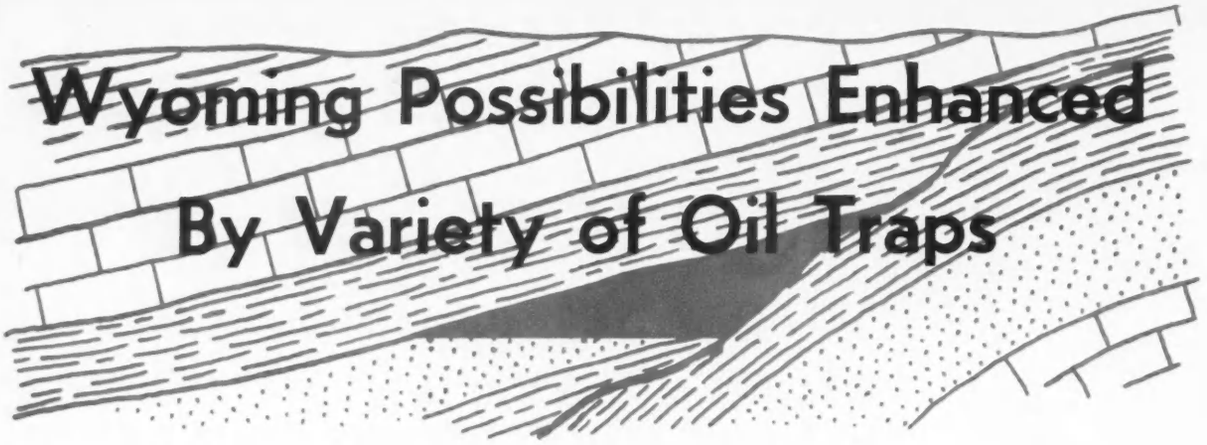
### QUICK POSITIVE RELEASE

Here's how the Baash-Ross Production Safety Joint operates to protect your tubing strings. The Joint consists essentially of a box and pin releasing thread (either right or left hand, as ordered) that is packed off top and bottom with self-sealing "O" rings. In the upper portion of the pin thread, two vertical lugs are machined into the body, and these lugs mate with a corresponding lug machined into the box portion.

The releasing threads are cut with a loose fit—that is, when the Joint is made up, the two portions can move a short distance longitudinally with respect to one another without affecting the vertical alignment of the Joint. This movement permits the mating lugs to lock and unlock as one portion of the Joint is moved with respect to the other portion—and the design of the lugs determines whether the Joint unlocks in tension or in compression. A shear pin is also provided that permits longitudinal movement of the Joint, but prevents premature rotational release.

Basically, the releasing action consists of first unlocking the lugs by lowering (or raising) the string—then rotating the string in the proper releasing direction (either right or left) to sever the shear pin and unscrew the Joint. Only by first moving the string in the proper vertical direction, then rotating it in the correct releasing direction, can the Joint be disengaged—and by properly selecting the releasing action, other tools below can be set and released without risk of disengaging the Joint.

# Wyoming Possibilities Enhanced By Variety of Oil Traps



By HORACE D. THOMAS

Professor of Geology and State Geologist,
University of Wyoming, Laramie

**OIL POSSIBILITIES in Wyoming have been greatly increased by evidence that petroleum accumulations exist not only on prominent anticlines but also on anticlines or domes not reflected at the surface, along faults, on homoclines, and in stratigraphic traps of varying nature, including those controlled strictly by sand conditions. Important new petroleum reserves should be found in Wyoming through varied exploratory effort, including further surface geology, geophysical work, and especially subsurface geology and study of stratigraphy and sedimentation.**

PETROLEUM exploration in Wyoming has been stimulated by the elimination of certain ideas which dominated geological thinking for many years. The belief that accumulation was strictly anticlinal has been precluded by the discovery of pools trapped in other ways. The idea that anticlinal closure must be in the magniture of several hundred feet or more before an anticline can serve as a trap has been proved false. The theory that rocks at depths greater than 7000 or 8000 feet would be too tight and impermeable to serve as reservoir rocks was not sustained by fact. The tenet that the Cretaceous sandstones were essentially blanket sands, without pinchouts or changes in facies or permeability, has been expunged. Fault traps, long looked upon with disfavor, seem to have possibilities.

Oil is produced in Wyoming from rocks as old as preCambrian and as young as Eocene. Within the thick sedimentary succession, many stratigraphic changes and sedimentary conditions may have served to trap oil. From time to time, stratigraphic units hitherto not known as oil producers have yielded oil, and new ones may join the list of producing units.

Surface exploration will continue significantly in the search for anticlines, for possible fault traps, or for structural anomalies at the surface indicating possible traps at depth. Geophysical exploration has proved effective in the search for structural traps in regions covered by unconformable Tertiary rocks and large areas are still amenable to such exploration. Stratigraphy and sedimentation will perhaps become the most important exploratory method in the search for new pools. A glance at the dry hole map of Wyoming[4] indicate the sparseness of subsurface stratigraphic control. Because many of the wells shown were drilled in early days, their logs are essentially useless. It has been in recent years only that adequate lithologic logs have been compiled and electric logs have been run. Today it is possible to assemble reliable subsurface data, and each new well adds to the picture.

It is apparent that the diverse ways in which oil and gas are now known to be trapped in Wyoming have greatly enhanced the petroleum possibilities, and that simple anticlinal accumulation is by no means the only potential. Obviously, for many years the lion's share of the production will continue to be from anticlinal fields, but it is good to know that the search for oil in Wyoming may well continue profitably beyond the time of drilling the last possible anticline.

The first producing oil well drilled in Wyoming was completed in 1884 in the Dallas field, Fremont County. The well was drilled near an oil seep which was shown to Captain Bonneville by Indian guides in 1833.[3] The Dallas oil seep was along the crest of the Dallas anticline, and thus the first oil produced from a well in Wyoming was from an anticlinal trap. Interestingly enough, this old field produced nearly 200,000 barrels of oil in 1950.

Oil seeps were known in the vicinity of the Salt Creek field before 1880, and in 1889 a well drilled downdip from a saturated-sand outcrop around the Salt Creek anticline discovered the Shannon pool. The second field, then, could be classed as a stratigraphic type trap, but when the first big producer was drilled on the crest of the anticline, resulting in the discovery of the Wall Creek sand production in the famous Salt Creek field, the Shannon pool faded into oblivion. Other anticlines early proved productive and by 1916, Big Muddy, Elk Basin, Garland, Grass Creek, Lost Soldier and other fields, all anticlinal in nature, had been discovered.

Thus began the search for anticlines, and for many years geologists, armed with plane tables and alidades, mapped the basin margins seeking "closed contours." Wyoming fields became known as excellent examples of the anticlinal accumulation of petroleum and natural gas.

Wells drilled on closed anticlines to depths which were then economical, occasionally resulted in the discovery of oil and gas fields; others were dry holes. Eventually most of the anti-

clines had been mapped, but new ones came to light in regions of cover or of poor exposures, or through pitting or core drilling to prove closure.

Obviously, as an exploratory tool, the search for anticlines through surface mapping was governed by the law of diminishing returns. To expand reserves there were two recourses; first, to drill deeper on anticlines which produced from shallow sands, or which had proved dry in shallow sands; second, to search by geophysical means for anticlines buried by unconformable Tertiary rocks. Both methods were successful. Some anticlines, like Elk Basin, which had been moderate producers from shallow sands, were prolific producers from deeper sands. Some which produced gas from shallower sands yielded oil from deeper sands, and some which had been dry in shallow sands produced oil from deeper sands. Even today, it appears that the total potentialities of any anticline cannot be evaluated until drilling has been carried to the preCambrian basement.

When surface geology had lost much of its effectiveness in locating untested anticlines, the seismograph came into importance, again seeking closed structures, but basinward ones were obscured by an unconformable mantle of Tertiary rocks. This technique paid dividends in the discovery of such important deep fields as Worland, Church Buttes, and others. Because of the great size of the relatively unexplored basins, more fields of this sort will surely be found.

### Early Developments

But during this period certain early developments, although not of great commercial importance, were heralds of things to come. Brigham Young and the Mormons, en route to Utah in 1847, had used oil from seeps in Uinta County, in the southwest corner of the state, for lubricant and medicine.[3] In 1900, oil encountered in a well that was being drilled for water led to the discovery of the Spring Valley field. Approximately 70 wells drilled in succeeding years resulted in about 30 producers. The cumulative production has been only about 200,000 barrels, but Spring Valley was unique in that the oil occurred in sands in a homocline; there were no closed contours.

Oil seeps had also been long known in the region along the west flank of the Powder River Basin. Seeps in the Moorcroft area were exploited before 1888,[3] when oil was collected from a dozen springs and was pumped from one well 300 feet deep. Of interest to present operators is the fact that the oil was transported to mining towns in the Black Hills where it was readily sold as lubricating oil for $28 per barrel. In 1912, a well which resulted in the discovery of the Osage field was drilled. In spite of the fact that there is no closed contour within the producing area—the structure being a simple homocline[2] this field has produced more than 6 million barrels of oil.

Naturally, during the course of anticlinal exploration, many wells were drilled "off structure" and resulted in dry holes. It appears now that they were not drilled far enough "off structure." It is the intent of this paper to point out that important new discoveries are being made through wildcats in locations which the early-day Wyoming geologist would have thought ridiculous. Fields

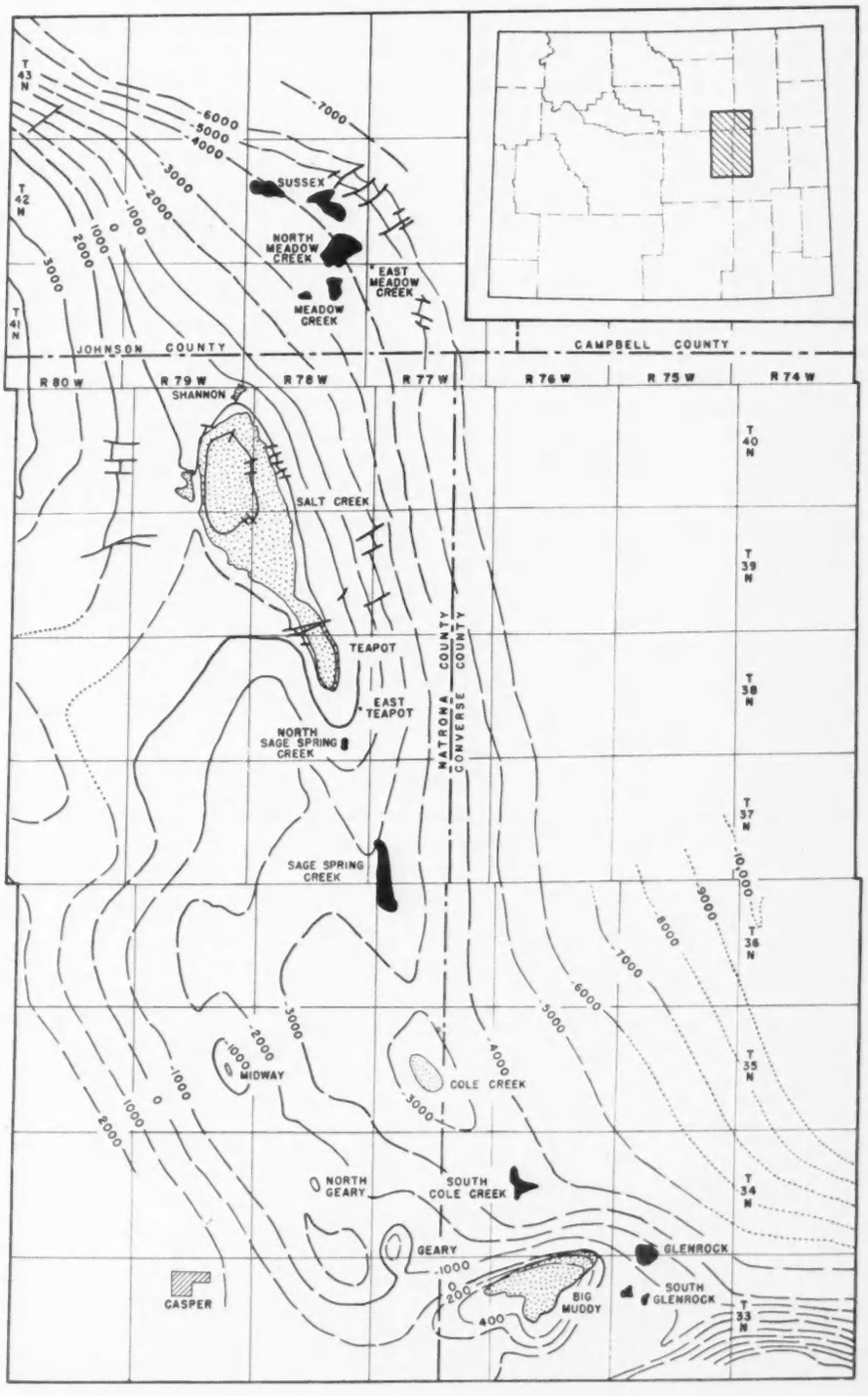



**FIGURE 1. Structure contour map of the southwest margin of the Powder River Basin, showing old anticlinal fields (stippled) and fields discovered since 1948 (black). Contour lines are on top of Cloverly. Small index map shows location of map area within Wyoming. (Modified from U.S.G.S. Preliminary Map 33, 1945.)**

are being discovered in regions tramped over by generations of geologists and condemned as being "off structure." Oil is being found in areas where no anticline can be mapped at the surface. New discoveries are being made under structural conditions which would have been classed as most unorthodox in earlier days. And this fact is important, for it opens a vast area which had once been thought to have no promise as the site for discovery of new oil fields.

As an example of the new exploratory trend—and discovery trend—in Wyoming, the area about the old Salt Creek and Big Muddy fields has been selected. This region lies on the southwest margin of the Powder River Basin, as shown on Figure 1, and occupies parts of Johnson, Natrona and Converse counties. Fields on the map which are located on anticlines mappable at the surface are Salt Creek, Big Muddy and Midway. Salt Creek, discovered in 1906, has produced more than 330 million barrels of oil; Big Muddy, discovered in 1916, has produced more than 32 million barrels of oil; and Midway, discovered in 1931, has produced only about 200,000 barrels of oil from three wells. Other anticlines in the region, such as Geary and North Geary, were found barren in shallower sands or were then considered too deep for testing.

On the basis of seismic work, the Cole Creek field was discovered in 1938. The field is anticlinal in nature and up to the present time has produced about 5 million barrels of oil. In 1948 seismic exploration led to the discovery of anticlinal production at South Cole Creek. For more than 40 years, therefore, the search had been for anticlinal production, either through surface observations or seismic surveys. Because it is commonly true in Wyoming that anticlines are not filled with oil down to the spill-points, but that production extends only part way down the flanks, a water well drilled down-structure on an anticline was thought to condemn all structurally lower areas. Furthermore, it was believed that any wells drilled below the lowest closing contour were certain to be water wells. Until several years ago, then, it appeared that because all the major anticlines in the Salt Creek-Big Muddy area had been found, the petroleum-producing potentialities of the area were fairly well exhausted.

### New Developments

At the beginning of 1951, however, the situation is in marked contrast with that of previous years. During the past two years, seven producing fields have been discovered in this region which are not located on conspicuous surface anticlines and, according to earlier thinking, are off structure.

SUSSEX-MEADOW CREEK AREA. The Sussex-Meadow Creek area is on the northeast flank of the Salt Creek anticline. Here the width of outcrop of the Lance formation is considerably greater than farther south, indicating a terracing, or flattening of the dip. The outcrop of the Fort Union formation, where it swings to the west, is marked by a number of small faults and there are some obscure local reversals in dip in the underlying Lance formation. Other than this fact, there is no surface suggestion that one of the state's most important oil fields lies below. The discovery well at Sussex, completed in July, 1948, by Continental Oil Company, was located on the basis of seismic exploration which suggested a possible trap at depth. North Meadow Creek was discovered in December, 1949; Meadow Creek in April, 1950; and East Meadow Creek in October, 1950. The fields are still being developed, and a great deal of additional subsurface information is needed to clarify exactly how accumulation is controlled. In the Sussex field, accumulation in the Sussex sand and the Shannon sand (Table 1) is apparently controlled by faulting, as is Lakota accumulation in the eastern part. In the western part, however, Lakota production appears to be related to folded closure. Production in the North Meadow Creek field seems to be controlled by normal faulting. Meadow Creek is not faulted to as great a degree as Sussex and North Meadow Creek. The largest faults have about 100 feet of displacement and may have some effect on accumulation in the Shannon and Wall Creek sands. In February, 1951, the first suggestion of a reversal in dip toward the Salt Creek anticline was noted in a well which showed 25 to 30 feet of reverse dip on the Lakota sand in a quarter of a mile. Development has not progressed to the point, however, where it can be said that accumulation is controlled by faulting, by doming, by sand conditions, or by a combination of these factors. At any rate, Meadow Creek does not fit the concept of what used to be considered an orthodox Wyoming oil field.

Five sands have proved productive in these fields; the Sussex, the Shannon, the First and Second Wall Creek sands, and the Lakota. The Sussex sand had not been known as an oil-producer until the Sussex-Meadow Creek area was discovered. During 1950, these fields were the site of more developmental drilling than any other area in the state. From the time of discovery until the end of 1950, 114 wells had been drilled, with only 12 dry holes.

SAGE SPRING CREEK. In 1949 a well was completed by Amerada Petroleum Corporation on the south plunge of the Salt Creek-Teapot Anti-

**TABLE 1**

**Cretaceous Formations in the Southwestern Part of the Powder River Basin**

| SYSTEM | SERIES | FORMATION | | OIL SANDS |
|---|---|---|---|---|
| TERTIARY | EOCENE | Wasatch formation | | |
| | PALEOCENE | Fort Union formation | | |
| CRETACEOUS | UPPER CRETACEOUS | Lance formation | | |
| | | Fox Hills sandstone | | |
| | | Mesaverde formation | | |
| | | Cody shale | Steele | Sussex sand |
| | | | | Shannon sand |
| | | | Niobrara | |
| | | Frontier formation | | Wall Creek sands |
| | | Mowry shale | | |
| | | Muddy sandstone | | Muddy sand |
| | LOWER CRETACEOUS | Thermopolis shale | | |
| | | Cloverly formation | | Dakota sand |
| | | | | Lakota sand |
| JURASSIC | | Morrison formation | | |

cline for a small producer in the Dakota sand. The fourth well, drilled two miles south of the discovery, ran several hundred feet lower structurally and showed different sand conditions. Up to the present time, nine producers and four dry holes have been drilled. The best well had an initial output of 184 barrels per day. Accumulation is controlled purely by sand conditions and production is not effected from a closed anticlinal structure.

In August, 1949, a discovery was made six miles north of the Sage Spring Creek discovery well, and at present there are three flowing wells in the field. This area is referred to as North Sage Spring Creek. Two dry holes have been drilled between North Sage Spring Creek and Sage Spring Creek proper.

These fields are on the south plunge of the Salt Creek-Teapot Anticline and there is apparently a regular southward dip. In North Sage Spring Creek the Dakota sand is nearly 3000 feet lower structurally than in the Salt Creek field and outside the lowest closing contour on the Salt Creek-Teapot anticline. The southernmost producer in Sage Spring Creek is 1600 feet lower structurally than the wells in North Sage Spring Creek. Dakota sand production has been almost negligible in the Salt Creek field, yet this sand is the producer on the south plunge—a fact supporting the belief that accumulation in the Sage Spring Creek fields is related to favorable sand conditions along the structurally low plunge of the Salt Creek-Teapot anticline. Sand thickness and permeability, which ranges from zero to 340 millidarcys, serve to control accumulation. These new productive areas would have been considered "off structure" and below the water table in earlier days.

GLENROCK. In December, 1949, just north of the town of Glenrock, the discovery well in the Glenrock field was brought in, producing from the Muddy sand at a structural position some 3200 feet lower than the crest of the Big Muddy anticline and about six miles east of the highest part of the Bid Muddy dome. The Muddy sand is not present in the Big Muddy field proper, and it appeared that accumulation was related to the wedge-edge of the sand on the east plunge of the anticline. Several months later, production was also developed in the Dakota sand, which is a producer in the Big Muddy field. This latter well, only a short distance from the Muddy sand discovery well, penetrated no Muddy sand, and thus implied a pinchout. In January, 1951, Muddy sand production was extended westward three miles to the margin of the Big Muddy field. On the other hand, in 1946, Dakota production in the Big Muddy field proper had been extended eastward and to a position structurally lower than the lowest closed contour. It appears, then, that the region on the east plunge of the Big Muddy anticline, an area which earlier would have been considered off structure, is characterized by sand conditions which have served to trap oil. Some geologists have felt that transverse faulting acros the anticlinal plunge might account for the Dakota production at Glenrock, but as yet there is no definite evidence of such a structural condition.

SOUTH GLENROCK. The Big Muddy dome and the surrounding region were mapped by Barnett in 1915.[1] In his accompanying report, he remarked that the U. S. Geological Survey was constantly searching for domes as an aid to prospectors and said: "Although the Survey does not guarantee that oil will be found in any of these domes, its position is that domes are the most promising localities; and if the drill proves that they do not contain oil, it is useless to search in other places." This tenet was followed for many years, and it was not until 35 years later, in July, 1950, that oil was discovered at South Glenrock in an area which had held no attraction because it was too low structurally. So far seven wells have been completed in the Muddy or the Dakota sands, the Muddy discovery well flowing 1872 barrels per day. In late January, 1951, a dual completion well flowed more than 1500 barrels of green oil per day from both sands.

*About the Author*

DR. HORACE D. THOMAS received B.A. and M.A. degrees in geology from the University of Wyoming and later attended Columbus University where he attained his Ph.D. degree in 1935. He started teaching at the University of Wyoming in 1931 and in 1941 was appointed State Geologist and Director of the Geological Survey of Wyoming. On March 1, 1951, he was reappointed for a six-year term.

### Unusual Fields in Other Areas

Nonanticlinal oil fields are known elsewhere in Wyoming. Those which have received major attention lately are located on the west flank of the Black Hills and are represented by the old Osage field and the newer Mush Creek, Fiddler Creek, Skull Creek, Lodgepole, Clareton and other pools. Production is mainly from the Newcastle sand on the westward-dipping homocline, and accumulation is controlled by permeability changes in that sand.[2,5]

Fields in which accumulation is related primarily to faulting have not been common in Wyoming, nor have such structures been attractive for exploration. It is true that in some of the old anticlinal fields cut by transverse faults, individual fault blocks may act as units, but such accumulation is essentially anticlinal in nature. Some fields have been discovered in recent years, however, in which there would have been no accumulation were it not for faulting, such as Silvertip, on the west flank of the Elk Basin anticline in Park County, and Lightning Creek, in the Lance Creek area, Niobrara County.

#### REFERENCES


There are a number of publications and maps of a general nature which might prove of interest to the reader should he desire a more complete background regarding the geology and petroleum resources of Wyoming. It is impossible to give references to all the pertinent ones, yet a few are listed below. The geological history and structure of the state are given in condensed form in a bulletin issued by the Geological Survey of Wyoming.[6] A recent map showing oil and gas fields, dry holes, anticlinal axes, unit areas, and pipelines has been issued by the U. S. Geological Survey.[4] A compilation of the history and development of the oil and gas fields of the state, up to 1938, has been isued by the Bureau of Mines.[3]

[1] Barnett, V. H., "Possibilities of Oil in the Big Muddy Dome, Converse and Natrona County, Wyoming," U. S. Geological Survey Bulletin 581-C, 1915.

[2] Dobbin, C. E., and Horn, G. H., "Geology of the Mush Creek and Osage Oil Fields and Vicinity, Weston County, Wyoming," U. S. Geological Survey Preliminary Map 103, 1949.

[3] Espach, Ralph H., and Nichols, H. Dale, "Petroleum and Natural-Gas Fields in Wyoming," U. S. Bureau of Mines Bulletin 418, 1941.

[4] Keefer, E. K., *et al.*, "Map of Wyoming showing test wells for oil and gas, anticlinal axes, oil and gas fields, pipe lines, unit areas, and land district boundaries," U. S. Geological Survey Preliminary Map 107, Dec., 1949.

[5] Summerford, H. E., Schieck, E. E., and Heistand, T. C., "Oil and Gas Accumulation Controlled by Sedimentary Facies in Upper Cretaceous Newcastle Sandstone, Wyoming," Bulletin American Association Petroleum Geologists, Vol. 34, No. 9, 1950, pp. 1887-1896.

[6] Thomas, Horace D., "Geological History and Geological Structure of Wyoming," Geological Survey of Wyoming Bulletin 42, 1949.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# "American Tiger Brand

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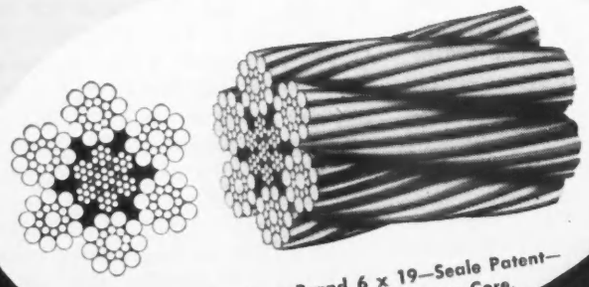

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WHAT'S THE BEST ROTARY DRILLING LINE? Contractors like Tiger Brand 6 x 19 Seale Patent Monitor Excellay Preformed IWRC. It gives most ton-miles of service per dollar of wire rope cost. Photo shows Clif Tomberlin, driller for Fleet Drilling Company on rig No. 2.

# Exploration

## Quickens After Lull

A TOTAL of 725 exploratory tests were completed during March as drilling gathered speed after a slowdown during February. The month's wells were substantially greater in number than February's 535, but not so numerous as the 796 completed in January. However, about 100 more tests were drilled during the month than had been completed in the same period last year.

Not included in the above completed wells total were two wildcats in widely separated parts of the U. S. that were not yet officially completed, but were the month's most talked of wildcat wells. One of those was the test that added North Dakota's name as the 27th on the list of oil producing states. The other was the independently drilled Mississippi wildcat that seems headed for, and was only a relatively few feet away from, a new world's depth record.

North Dakota was given its first commercial oil production by Amerada Petroleum Corporation's Iverson 1, in Williams County, northwestern part of the state. The well was gauging about 275 barrels of 53-gravity oil per day through perforations at 11,630 feet.

The second deepest well in the world, deepest east of the Mississippi River, is George Vasen and others' Tung Oil Corporation of America 1, Stone County, southern Mississippi. Drilling was continuing below 20,441 feet. That was only 80 feet short of the world mark of 20,521 feet set by The Superior Oil Company in Wyoming.

**Summary of Results of Exploratory Drilling**

| ITEM | Mar., 1951 | Feb., 1951 | THREE MONTHS: January-March 1951 | 1950 | Percent Diff. |
|---|---|---|---|---|---|
| **Oil Discoveries** | 108 | 74 | 277 | 227 | + 22.0 |
| New Fields | 70 | 46 | 188 | 156 | + 20.5 |
| New Pays | 38 | 28 | 89 | 71 | + 25.4 |
| **Distillate Discoveries** | 5 | 4 | 17 | 21 | — 19.1 |
| New Fields | 3 | 2 | 12 | 18 | — 33.4 |
| New Pays | 2 | 2 | 5 | 3 | + 66.7 |
| **Gas Discoveries** | 17 | 12 | 45 | 38 | + 18.4 |
| New Fields | 13 | 8 | 34 | 34 | ..... |
| New Pays | 4 | 4 | 11 | 4 | +175.0 |
| **Total Discoveries** | 130 | 90 | 339 | 286 | + 18.5 |
| **Extensions to Fields** | 22 | 10 | 62 | 74 | — 16.2 |
| Oil Fields | 15 | 6 | 44 | 64 | — 31.3 |
| Distillate Fields | 1 | 2 | 7 | 3 | +133.3 |
| Gas Fields | 6 | 2 | 11 | 7 | + 57.2 |
| **Total Prod. Tests** | 152 | 100 | 401 | 360 | + 11.4 |
| **Dry Holes** | 573 | 435 | 1,655 | 1,439 | + 15.0 |
| Wildcats | 529 | 407 | 1,546 | 1,363 | + 13.4 |
| New Pays | ..... | 1 | 4 | 4 | ..... |
| Outposts | 44 | 27 | 105 | 72 | + 45.8 |
| **Total Expl'tory Tests** | 725 | 535 | 2,056 | 1,799 | + 14.3 |
| Percent Productive | 21.0 | 18.7 | 19.5 | 20.0 | ..... |
| Percent Dry | 79.0 | 81.3 | 80.5 | 80.0 | ..... |

**Results of Exploratory Drilling in March and First 3 Months, 1951-1950, by Districts**

| State or District | MONTH OF MARCH, 1951 | | | | | | | | | | | | | FIRST THREE MONTHS, 1951 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Productive Tests | | | | | | | | | Total Productive | Unproductive Tests | | | Total Exploratory Tests | Productive Tests | | | | | | | | Total Productive | | Unproductive Tests | | | | Total Exploratory Tests | |
| | New Fields | | | New Pays | | | Extensions | | | | Wildcats | New Pays | Outposts | | New Fields | | | New Pays | | | Extensions | | | | | | | | | |
| | Oil | Dis. | Gas | Oil | Dis. | Gas | Oil | Dis. | Gas | | | | | | Oil | Dis. | Gas | Oil | Dis | Gas | Oil | Dis. | Gas | 3 Mo. 1951 | 3 Mo. 1950 | Wildcats | New Pays | Outposts | Total Dry 3 Mo. 1951 | Total Dry 3 Mo. 1950 | 3 Mo. 1951 | 3 Mo. 1950 |
| Alabama | | | | | | | 1 | | | 1 | 1 | | | 2 | | | | 1 | | | 1 | | | 2 | 1 | 3 | | | 3 | 5 | 5 | 6 |
| Arizona | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | 2 | | | 2 | | | |
| Arkansas | 1 | | | 1 | | | | | | 2 | 4 | | 2 | 8 | 1 | | | 1 | | | | | | 2 | 2 | 10 | | 3 | 13 | 19 | 15 | 21 |
| California | 1 | | | 1 | | | 1 | | | 3 | 29 | | 7 | 39 | 3 | | 1 | 3 | | | 2 | | | 9 | 12 | 121 | 2 | 12 | 135 | 82 | 144 | 94 |
| Colorado | | | | | | | | | | | 3 | | | 3 | | | | | | | | | | | | 18 | | 1 | 19 | 5 | 19 | 5 |
| Florida | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 4 |
| Georgia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 3 |
| Idaho | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | 1 | 1 |
| Illinois | | | | 1 | | | 2 | | | 3 | 24 | | | 27 | 3 | | | 3 | | | 6 | | | 12 | 25 | 85 | | | 85 | 131 | 97 | 156 |
| Indiana | 5 | | | 1 | | | | | | 6 | 13 | | | 19 | 5 | | | 3 | | | | | | 8 | 9 | 51 | | | 51 | 85 | 59 | 94 |
| Kansas | 12 | | 1 | 4 | | | | | | 17 | 49 | | | 66 | 36 | | 2 | 9 | | | | | | 47 | 22 | 154 | | | 154 | 92 | 201 | 114 |
| Kentucky | 1 | | | 1 | | | | | | 2 | 5 | | | 7 | 1 | | | 2 | | | 2 | | | 5 | 2 | 24 | | | 24 | 8 | 29 | 10 |
| Louisiana | 3 | | | 1 | | 1 | 1 | | | 6 | 24 | | 1 | 31 | 9 | | 1 | 9 | 1 | 1 | 4 | | | 25 | 25 | 60 | | 7 | 67 | 44 | 92 | 69 |
| North Louisiana | 1 | | | | | 1 | 1 | | | 3 | 15 | | | 18 | 3 | | | 2 | 1 | 1 | 2 | | | 9 | 6 | 32 | | 1 | 33 | 21 | 42 | 27 |
| South Louisiana | 2 | | | 1 | | | | | | 3 | 9 | | 1 | 13 | 6 | | 1 | 7 | | | 2 | | | 16 | 19 | 28 | | 6 | 34 | 23 | 50 | 42 |
| Maryland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Michigan | 3 | | 1 | | | | | | | 4 | 29 | | | 33 | 3 | | 2 | | | 1 | | | | 6 | 9 | 57 | | | 57 | 67 | 63 | 76 |
| Mississippi | | 1 | | 1 | | | | | | 2 | 10 | | | 12 | 1 | 2 | | 2 | | | | | | 5 | 6 | 24 | | 3 | 27 | 37 | 32 | 43 |
| Missouri | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| Montana | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | 2 | | 2 | 4 | 9 | 5 | 9 |
| Nebraska | | | | | | | | | 2 | 2 | 4 | | | 6 | 2 | | | | | | | | 2 | 4 | 2 | 9 | | 2 | 11 | 9 | 15 | 11 |
| Nevada | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 1 | | 1 |
| New Mexico | 2 | | 1 | | | | | | | 3 | 3 | | 2 | 8 | 2 | | 3 | 3 | | | 2 | | 1 | 11 | 11 | 15 | | 3 | 18 | 15 | 29 | 26 |
| North Dakota | | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | 1 | | | 1 | | 1 | |
| Ohio | | | | | | | | | 1 | 1 | 4 | | | 5 | | | | | | | 1 | | 3 | 4 | 2 | 7 | | | 7 | 4 | 11 | 6 |
| Oklahoma | 6 | | 1 | 3 | | | 3 | | 1 | 14 | 57 | | | 71 | 16 | | 2 | 6 | | | 7 | 1 | 2 | 34 | 32 | 160 | | | 160 | 106 | 194 | 138 |
| South Dakota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| Tennessee | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 3 |
| Texas | 35 | 2 | 9 | 21 | 2 | 3 | 5 | 1 | 2 | 80 | 260 | | 30 | 370 | 103 | 10 | 22 | 42 | 4 | 8 | 15 | 6 | 3 | 213 | 197 | 716 | 2 | 68 | 786 | 678 | 999 | 875 |
| Dist. 1 S. Central | 4 | | | 1 | | | | | | 5 | 18 | | 1 | 24 | 8 | | | 1 | | | | | | 9 | 5 | 42 | | 4 | 46 | 51 | 55 | 56 |
| Dist. 2 Middle Gulf | 2 | 1 | 2 | 2 | | 2 | 1 | | | 10 | 12 | | 10 | 32 | 4 | 4 | 6 | 4 | | 4 | 1 | | | 23 | 15 | 40 | | 14 | 54 | 27 | 77 | 42 |
| Dist. 3 Upper Gulf | 1 | 1 | 3 | 5 | 2 | | 1 | | | 13 | 23 | | 1 | 37 | 4 | 2 | 5 | 12 | 2 | 1 | 1 | 1 | | 28 | 24 | 59 | | 2 | 61 | 46 | 89 | 70 |
| Dist. 4 L. Gulf-S.W. | 3 | | | 4 | | 1 | 1 | | 1 | 10 | 23 | | 6 | 39 | 7 | 3 | 1 | 9 | 1 | 2 | 1 | | 1 | 25 | 31 | 63 | 1 | 12 | 76 | 67 | 101 | 98 |
| Dist. 5 E. Central | | | | 1 | | | 1 | | | 2 | 18 | | | 20 | 1 | | | 1 | | | 2 | | | 4 | 1 | 51 | | | 51 | 17 | 55 | 18 |
| Dist. 6 Northeast | 1 | | | | | | | 1 | | 2 | 9 | | | 11 | 2 | | | | | | | 5 | | 7 | 6 | 18 | | | 18 | 30 | 25 | 36 |
| Dist. 7-B-N. Cent. | 11 | | 3 | 4 | | | | | 1 | 19 | 56 | | | 75 | 28 | | 6 | 5 | | | 1 | | 2 | 42 | 35 | 178 | | 3 | 181 | 138 | 223 | 173 |
| Dist. 7-C-W. Cent. | 4 | | 1 | 2 | | | | | | 7 | 25 | | 2 | 34 | 14 | 1 | 1 | 2 | 1 | | 4 | | | 23 | 13 | 65 | | 2 | 67 | 58 | 90 | 71 |
| Dist. 8 West | 2 | | | | | | | | | 2 | 24 | | 1 | 27 | 13 | | 2 | 3 | | | 3 | | | 21 | 33 | 87 | 1 | 8 | 96 | 79 | 117 | 112 |
| Dist. 9 North | 7 | | | 2 | | | 1 | | | 10 | 52 | | 9 | 71 | 21 | | | 5 | | 1 | 2 | | | 29 | 33 | 111 | | 23 | 134 | 161 | 163 | 194 |
| Dist. 10 Panhandle | | | | | | | | | | | | | | | 1 | | 1 | | | | | | | 2 | 1 | 2 | | | 2 | 4 | 4 | 5 |
| Utah | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 | 1 | 4 | | | 4 | 4 | 5 | 5 |
| Washington | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| West Virginia | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | | | | | 1 | |
| Wyoming | 1 | | | 3 | | | 2 | | | 6 | 8 | | 2 | 16 | 2 | | | 5 | | 1 | 3 | | | 11 | 2 | 21 | | 4 | 25 | 22 | 36 | 24 |
| Total U. S. | 70 | 3 | 13 | 38 | 2 | 4 | 15 | 1 | 6 | 152 | 529 | | 44 | 725 | 188 | 12 | 34 | 89 | 5 | 11 | 44 | 7 | 11 | 401 | 360 | 1546 | 4 | 105 | 1655 | 1439 | 2056 | 1799 |

# U. S. Oil, Distillate and Gas Discoveries and Extensions in March

### ALABAMA—OIL FIELD EXTENSION

**Clarke County, South Carlton field.** Humble Oil & Refining Company's J. H. Wall Estate 2, C SE NW 10-3n-2e, 1-mile north extension, pumped 137 barrels from Tuscaloosa sand, Upper Cretaceous 5398-5405 feet. 14.7-gravity, completed 3-4-51, TD 5455.

### ARKANSAS—NEW OIL FIELD

**Miller County.** Lee & Markam Production Company and A. C. Allyn's Price 1, in 18-16s-25w, pumped 70 barrels plus 60 barrels water from Paluxy sand, Lower Cretaceous 3311-3314 feet, 13.8-gravity, completed 3-21-51, TD 4368.

### ARKANSAS—NEW OIL PAY

**Union County, Nick Springs, West field.** Pan-Am Southern Corporation's C. W. Everett 1, in 36-17s-15w, pumped 11 barrels from Travis Peak sand, Upper Cretaceous 3315-3318 feet, completed 3-26-51, TD 3644.

### CALIFORNIA—NEW OIL FIELD

**Monterey County.** Jergins Oil Company's Aurignac 1, in 9-23s-10e, pumped 14 barrels from 3480-3510 feet, 14-gravity, completed 3-21-51, TD 4341.

### CALIFORNIA—NEW OIL PAY

**Kern County, Tejon Hills, Southwest field.** Standard Oil Company of California's Tejon 3-58-21, in 21-11n-18w, flowed 147 barrels plus 51 barrels water from Olcese sand, Miocene 962-1025 feet, 27.1-gravity, 24/64-inch, completed 2-20-51, TD 1344.

### CALIFORNIA—OIL FIELD EXTENSION

**Los Angeles County, Castaic Junction field.** Humble's N.L.&F. 4, SW NW 19-4n-16w, ¾-mile east extension, flowed 734 barrels from Mohnian sand, Miocene 10,328-10,609 feet, 20.8-gravity, ¼-inch, completed 3-16-51, TD 10,651.

### ILLINOIS—NEW OIL PAY

**Wayne County, Orchardville field.** Collins Brothers Oil Company's Rutherford Heirs 1, SE NE SE 29-1n-5e, pumped 29 barrels plus 20 barrels water from Aux Vases sand, Mississippian 2794-2808 feet, completed 3-27-51, TD 2808.

### ILLINOIS—OIL FIELD EXTENSION

**Richland County, Clay City-Noble Consolidated field.** J. Bander et al's N. Diesser 2, NE NE NW 1-3n-9e, 1-mile east extension, pumped 52 barrels from Rosiclare lime, Mississippian 2976-2997 feet, completed 3-13-51, TD 3029.

**Richland County, Clay City-Noble Consolidated field.** Mark Twain Oil Producing Company's L. Kaskie 1, NE NW NE 23-3n-9e, 1-mile extension, pumped 85 barrels from Rosiclare lime, Mississippian 3007-3012 feet, completed 3-13-51, TD 3025.

### INDIANA—NEW OIL FIELDS

**Clay County, Saline City field.** Clark County Oil Research Corporation's C. E. and Edna Long 1, SE SW SW 23-11n-7w, pumped 50 barrels from Devonian lime, Devonian 1480-1496 feet, TD 1496.

**Knox County, Bicknell field.** W-G-R Drilling Company's Earl Wampler 2, in Mil Don 152-4n-8w, pumped 80 barrels from Rosiclare lime, Mississippian 1382-1384 feet, TD 1384.

**Knox County.** Iliana Exploration Company's Frank S. & Thelma Roark 1, in Mil Don 63-2n-8w, pumped 35 barrels from Aux Vases lime, Mississippian 1440-1445 feet, TD 1501.

**Knox County, Monroe City, West field.** Huntington Oils, Incorporated's Emmett Carter 1, in Mil Don 11-2n-9w, pumped 35 barrels from McClosky lime, Mississippian 1535-1539 feet, TD 1542.

**Posey County.** Calvert Drilling Company and C. L. McMahon Incorporated's Keck Heirs 1, SE NW NE 18-7s-12w, pumped 45 barrels from McClosky lime, Mississippian 2688-2696 feet, TD 2696.

### INDIANA—NEW OIL PAY

**Daviess County, Elnora field.** Harrison Eiteljorg's Seth D. Sims 1, SE SE NW 35-5n-6w, pumped 96 barrels from St. Louis lime, Mississippian 1010-1020 feet, TD 1080.

### KANSAS—NEW OIL FIELDS

**Barton County, Dartmouth field.** B & R Drilling Company's Johnson 1, SW SW SW 27-19s-12w, pumped 174 barrels from Arbuckle lime, Ordovician 3362-3371 feet, TD 3371.

**Butler County.** Rex & Morris Oil Company et al's Sparks 1, SW NE SE 20-25s-4e, pumped 25 barrels from Mississippi lime, Mississippian 2490-2539 feet, TD 2860.

**Ellsworth County, Mathews field.** Imperial Petroleum Company's Mathews 1, NW SE NW 19-17s-10w, flowed 1013 barrels from Lansing-KC lime, Pennsylvanian 2990-3085 feet, TD 3085.

**Phillips County, Dry Creek field.** Honaker Drilling Company's Gebhardt 1, NW NE NW 7-1s-18w, pumped 6 barrels from Lansing-KC lime, Pennsylvanian 3408-3412 feet, TD 3449.

**Phillips County, Glenwood field.** Bay Petroleum Corporation and Westgate-Greenland Oil Company's Rolland 1, SW SW SW 21-1s-17w, pumped 83 barrels from Lansing-KC lime, Pennsylvanian, TD 3758.

**Phillips County, Kent field.** Honaker's Kent 1, NE SE SE 22-1s-18w, pumped 20 barrels from Lansing-KC lime, Pennsylvanian 3432-3492 feet, TD 3505.

**Rooks County, Berland, Northwest field.** Barnett Oil Company's Coddington 1, SE SE SE 2-10s-20w, pumped 122 barrels from Arbuckle lime, Ordovician 3783-3789 feet, TD 3789.

**Rooks County.** Heathman Drilling Company's Bassett 1, SW SW SE 20-10s-20w, pumped 124 barrels from Arbuckle lime, Ordovician 3747-3762 feet, TD 3767.

**Stafford County, Bart-Staff field.** Tom Palmer's Boyd 1, NW NW NW 4-21s-14w, potential 1192 from Arbuckle lime, Ordovician 3572-3577 feet, TD 3577.

**Stafford County, Hickman field.** Armer Drilling Company's Gates B-1, SE SE SW 27-21s-14w, flowed 2457 barrels from Lansing-KC lime, Pennsylvanian 3532-3542 feet, TD 3787.

**Stafford County, McGinty, Northwest field.** J. W. Bird's Wright 1, NE NE NE 14-21s-14w, pumped 258 barrels from Lansing-KC lime, Pennsylvanian 3483-3488 feet, TD 3699.

**Stafford County, Sleeper field.** Lewis Drilling Company's Sleeper 1, SW SW SE 22-22s-11w, pumped 683 barrels from Sooy conglomerate, Pennsylvanian 3579-3588 feet, 50-gravity, TD 3588.

### KANSAS—NEW OIL PAYS

**Ellis County, Burnett Southwest field.** Midstates Oil Corporation's Wasinger 7-B, SE NE NE 21-11s-18w, pumped 6 barrels from Simpson lime, Ordovician 3582-3586 feet, TD 3618.

**Rooks County, Grover field.** Magnolia Petroleum Company's Holsman 1, SE SE SE 15-7s-19w, pumped 30 barrels from Arbuckle lime, Ordovician 3398-3421 feet, TD 3421.

**Stafford County, Hickman field.** Armer Drilling's Gates B-2, in 27-21s-14w, pumped 286 barrels from Simpson lime, Ordovician 3747-3753 feet, TD 3780.

**Stafford County, Richardson field.** Deardorf Oil Corporation's Spangenberg 1, SE SW NE 29-22s-11w, pumped 185 barrels from Lansing-KC lime, Pennsylvanian 3264-3300 feet, TD 3613.

### KANSAS—NEW GAS FIELD

**Clark County.** Skelly Oil Company's Theis 1, SW SW NE 5-34s-25w, flowed 7 million from Mississippi lime, Mississippian 5532-5905 feet, TD 6041.

### KENTUCKY—NEW OIL FIELD

**Daviess County, Russell School field.** Simon Lebow's Nile Moseley 1, C NE NE 2-M-30, pumped 50 barrels from Tar Springs sand, Mississippian 946-963, feet, TD 964.

### KENTUCKY—NEW OIL PAY

**Henderson County, Hebbardsville field.** John B. Buchman and C. E. O'Neal and Company's L. M. E. Boswell 1, in 24-P-26, pumped 42 barrels plus 10 barrels water from O'Hara lime, Mississippian 2214-2223 feet, TD 2305.

### NORTH LOUISIANA—NEW OIL FIELD

**Sabine Parish.** Major Oil Company's Long Bell Lumber Company 1-A, in 24-8n-14w, pumped 16 barrels from 2333-2391 feet, completed 3-15-51, TD 3405.

### NORTH LOUISIANA—OIL FIELD EXTENSION

**Bossier Parish, Sarepta, South field.** Magnolia's Ansel M. Stroud 1, in 16-22n-11w, 1-mile north extension, flowed 129 barrels from Ardis sand, Jurassic 9362-9375 feet, 47.9-gravity, ¼-inch, completed 3-19-51, TD 10,083.

### NORTH LOUISIANA—NEW GAS PAY

**Lincoln Parish, Simsboro field.** Murphy Corporation and Pan Am Southern's Givens 1, SW NW 11-17n-4w, flowed 4.4 million from James lime, Lower Cretaceous (New Pay) 5714-5726 feet, 18/64--inch, and 2.1 million from Gardner sand, Lower Cretaceous (East Extension) 6528-6548 feet, 18/64-inch, completed 3-3-51, TD 10,098.

### SOUTH LOUISIANA—NEW OIL FIELDS

**Lafourche Parish.** Superior Oil Company's Clovelly Corporation 1, NW NW 33-18s-22e, flowed 194 barrels from 12,305-12,315 feet, 32.2-gravity, 7/64-inch, completed 3-13-51, TD 13,930.

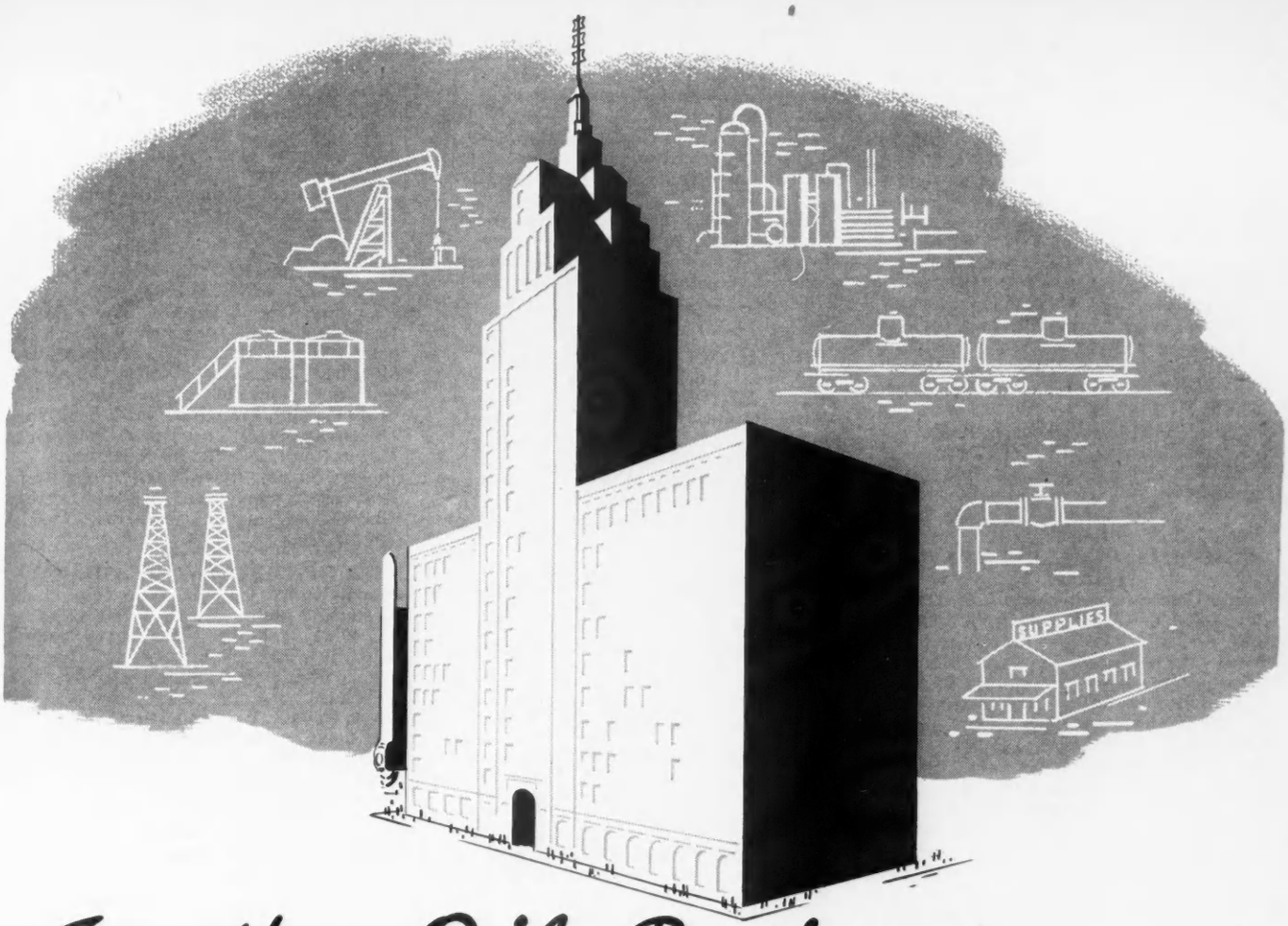
**Livingston Parish, "Lake Maurepas" field.** Roeser & Pendleton, Incorporated's State Lease 1468-1, Tract 3405 in Lake Maurepas, flowed 320 barrels from 9815-9850 feet, 47.8-gravity, 10/64-inch, completed 3-8-51, TD 10,270.

### SOUTH LOUISIANA—NEW OIL PAY

**Acadia Parish, Lewisburg, South field.** Howard Cole's A. Richard B-1, in 75-7s-3e, flowed 540 barrels from 10,722-10,726 feet, 43.5-gravity, 14/64-inch, completed 3-1-51, TD 10,751.

### MICHIGAN—NEW OIL FIELDS

**Midland County, Sanford field.** Michigan Oil Company's State-Jerome 1, NW SW NE 13-15n-1w, Jerome Township, flowed

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28 barrels from Dundee lime, Devonian 3683-3795 feet, ¼-inch, TD 3820.

**Ogemaw County, "Edwards" field.** Basin Oil Company's Winter 1, NE NE SW 15-21n-1e, Edwards Township, pumped 50 barrels plus 7 barrels water from Dundee lime, Devonian 3352-3372 feet, TD 3375.

**Ogemaw County.** Brazos Oil & Gas Company's Fisk Brothers 1, N½ SW NW 14-24n-1e, Foster Township, pumped 15 barrels plus 30 barrels water from Richfield lime, Devonian 4181-4251 feet, TD 5062.

### MICHIGAN—NEW GAS FIELD

**Mecosta County.** Mercer Oil Company, Incorporated and Smith Petroleum Company's Soper 1, NW SW SW 13-16n-10w, Green Township, flowed 0.2 million from Dundee and Reed City lime, Devonian 3531-3731, TD 3731.

### MISSISSIPPI—NEW OIL PAY

**Jefferson County, Fayette field.** Humble's A. M. Stewart 3, in 27-9n-1w, flowed 66 barrels from Wilcox sand, Eocene 3993-3996 feet, 28.7-gravity, ⅛-inch, completed 3-26-51, TD 6982.

### MISSISSIPPI—NEW DISTILLATE FIELD

**Jefferson County, Fayette, South field.** Sinclair Oil & Gas Company's R. T. Liddell 1, in 67-9n-1e, flow 265 barrels and 2.7 million from Lower Tuscaloosa sand, Upper Cretaceous 10,071-10,082 feet, 58.2-gravity, 14/64-inch, completed 3-29-51, TD 10,184.

### NEBRASKA—GAS FIELD EXTENSIONS

**Deuel County, Big Springs field.** Charles D. Edmonson's R. Zimmerman 1, NW NW SE 24-13n-43w, 2-mile northwest extension, flowed 11.6 million from Dakota "D" sand, Cretaceous 3240-3260 feet, TD 3450.

**Deuel County, Big Springs field.** Ideal Drilling Company's Reese 1, NW NW SW 8-13n-42w, 2-mile north extension, flow 42.5 million from Dakota "D" sand, Cretaceous 3276-3290 feet, TD 3478.

### NEW MEXICO—NEW OIL FIELDS

**Lea County.** Paul C. Teas' Bernie Dinnin 1, SE NE SE 24-20s-33e, pumped 124 barrels from Yates sand, Permian 3343-3373 feet, completed 3-14-51, TD 3420.

**Lea County.** Tide Water Associated Oil Company's State 1-D, C SE SE 32-16s-37e, flowed 722 barrels from Strawn sand, Pennsylvanian 11,080-11,150 feet, 41-gravity, ½-inch, TD 12,572.

### NEW MEXICO—NEW GAS FIELD

**Rio Arriba County.** A. G. Hill's White 1, C NW 36-25n-2w, flowed 0.6 million from Pictured Cliffs sand, Upper Cretaceous 3453-3482 feet, TD 3495.

### OHIO—GAS FIELD EXTENSION

**Richland County, Mt. Vernon field.** Fierbaugh, Lyons & Ringler's K. R. Morgan 1, SE NE 30, Worthington Township, flowed 1.5 million from Clinton sand, Silurian 2407-2412 feet, completed 3-22-51, TD 2417.

### OKLAHOMA—NEW OIL FIELDS

**Lincoln County.** C. R. Colpitt's Payton 1, SE SE NW 27-17n-3e, flowed 105 barrels from Lower Skinner sand, Pennsylvanian 3987-3998 feet, 41-gravity, 11/64-inch, TD 3998.

**Payne County, Cushing Lake field.** T. W. & J. M. Loffland's Stanolind-Amerada 1, NE SW SW 27-18n-4e, flowed 240 barrels plus 70 barrels water from Wilcox sand, Ordovician 4014-4025 feet, 47-gravity, 6/64-inch, TD 4025.

**Payne County.** Wilcox Oil Company's Gould 1, NW NW NW 25-20n-4e, pumped 49 barrels plus 33 barrels water from Lower Skinner sand, Pennsylvanian 3526-3536 feet, 36-gravity, TD 4012.

**Pottawatomie County, Shawnee Lake, East field.** Arrow Drilling Company's Farris 1 (OWWO), NW NE SE 24-10n-2e, pumped 32 barrels from Bartlesville sand, Pennsylvanian 5095-5115 feet, TD 5855.

**Pottawatomie County, Trousdale field.** Buttram Petroleum Company's State of Oklahoma 1, SE SE NE 36-7n-2e, pumped 16 barrels from Lower Calvin sand, Pennsylvanian 4316-4325 feet, 38-gravity, TD 4341.

**Seminole County, Sasakwa, North field.** Powel Briscoe, Incorporated's Casey 1, NW SE SE 24-6n-7e, flowed 140 barrels from Gilcrease sand, Pennsylvanian 2768-2783 feet, 39-gravity, 20/64-inch, TD 2785.

### OKLAHOMA—NEW OIL PAYS

**Noble County, Lucien field.** Bay Petroleum's Henn 1, NE NW NE 32-30n-2w, pumped 53 barrels plus 5 barrels water from Avant lime, Pennsylvanian 3610-3620 feet, 46-gravity, TD 5202.

**Osage County, Flat Rock, West field.** George F. Martin's Osage 3, SW NW SE 35-21n-11e, pumped 10 barrels from Hominy sand, Ordovician 2041-2052 feet, TD 2055.

**Payne County, Starr Valley field.** Amerada Petroleum Company's Grace White 1, NW NE SE 4-19n-3e, pumped 11 barrels plus 18 barrels water from Red Fork sand, Pennsylvanian 3990-3995 feet, TD 3995.

### OKLAHOMA—OIL FIELD EXTENSIONS

**Grady County, Knox field.** Dick Wegener's Todd 1, SW SE SE 1-3n-6w, ½-mile west extension, pumped 61 barrels from Hoxbar sand, Pennsylvanian 4722-4732 feet, TD 4865.

**Major County, Ringwood field.** Mazda Oil Company's Walker 1, NE SW SW 22-22n-41w, 2½-miles northwest extension, flowed 178 barrels from Manning sand, Pennsylvanian 6719-6834 feet, 6/32-inch, TD 7045.

**Okfuskee County, Rosenwald field,** Herndon Drilling Company's Joe Smith 1, SW NE SE 26-13n-8e, 1½-mile south extension, pumped 25 barrels from Union Valley-Cromwell sand, Pennsylvanian 3482-3491 feet, 34-gravity, TD 3566.

### OKLAHOMA—NEW GAS FIELD

**Hughes County.** Helmerich and Payne Oil Company's Myers 1, SW SW NE 9-7n-10e, flowed 1 million from Cromwell sand, Pennsylvanian 3568-3572 feet, open, TD 4922.

### OKLAHOMA—GAS FIELD EXTENSION

**Carter County, Tatums field.** Kerr-McGee Oil Industries, Incorporated's Williams 1, NW NW NW 11-1s-3w, 1½-mile east extension, flowed 5 million from Goodwin sand, Pennsylvanian 4610-4678 feet, 24/64-inch, TD 5078.

### TEXAS DISTRICT 1—NEW OIL FIELDS

**Bastrop County.** John H. Foster's Mrs. Bessie Grohman 1, J. A. Navarro Survey, pumped 110 barrels from Serpentine sand, Upper Cretaceous 1570-1607 feet, completed 1-20-51, TD 1607.

**Bexar County.** Fred Scharf's August H. Ernst 1, Francisco Rolen League and Labor Survey, pumped 7 barrels from 1233-1248 feet, 37-gravity, completed 3-7-51, TD 1248.

**Frio County, "Goldfinch" field.** Milam Drilling Company's J. C. Cox 1, Albert Fisher Survey 229, flowed 63 barrels from Navarro sand, Upper Cretaceous 4617-4630 feet, 35.5-gravity, 3/16-inch, completed 3-22-51, TD 4630.

**Wilson County.** H. J. Mosser et al's Clarabel DeWees Remschel 1, Manuel Barrera Grant, flowed 560 barrels from Buda lime, Upper Cretaceous 30-gravity, ¼-inch, completed 3-29-51, TD 8050.

### TEXAS DISTRICT 1—NEW OIL PAY

**McMullen County, County Line field.** Sunray Oil Corporation's J. E. Murphy 1, J. C. King Survey, ½-mile west of production, pumped 17 barrels plus 10 barrels water from Pettus sand, Eocene 3061-3065 feet, 21.4-gravity, completed 3-8-51, TD 3065.

### TEXAS DISTRICT 2—NEW OIL FIELDS

**Bee County.** The Texas Company's Sallie Ragsdale 1, A. J. Davis Survey, flowed 15 barrels from Wilcox sand, Eocene 8068-8072 feet, 38-gravity, ¼-inch, completed 2-15-51, TD 10,468.

**Jackson County, Francitas, North field.** Sun Oil Company & The Texas Company's Rogers Unit 1, S & M Subdivision, J. Powers Survey, flowed 208 barrels from Frio sand, Oligocene 8649-8651 feet, 48.2-gravity, ⅛-inch, completed 3-16-51, TD 10,000.

### TEXAS DISTRICT 2—NEW OIL PAYS

**Jackson County, Cordele, West field.** H. J. Porter's Rudolph Yaussi Estate et al 3, (OWDD), John McWhite Survey, flowed 20 barrels from 2798-2799 feet, 21-gravity, 5/64-inch, completed 3-18-51, TD 2805.

**Refugio County, Un-named field.** Union Oil Company of California's J. J. O'Brien 2, (OWDD), Refugio Town Tract Survey, flowed 82 barrels from 5853-5858 feet, 39.7-gravity, 9/64-inch, completed 3-8-51, TD 6550.

### TEXAS DISTRICT 2—OIL FIELD EXTENSION

**DeWitt County, Helen Gohlke field.** Shell Oil Company's Gohlke Heirs B-2, W. H. Crain Survey, ½-mile west-southwest extension, flowed 9 barrels from Wilcox sand, Eocene 8155-8165 feet, 33.3-gravity, 9/64-inch, completed 3-25-51, TD 8217.

### TEXAS DISTRICT 2—NEW DISTILLATE FIELD

**Calhoun County.** Fullerton Oil Company & Ryan Consolidated Oil Corporation's T. A. McDonald 1, Miguel Castillo League, flowed 12 barrels and 0.2 million from 9654-9684 feet, 53-gravity, 13/64-inch, completed 1-9-51, TD 9740.

### TEXAS DISTRICT 2—NEW GAS FIELDS

**Refugio County.** Kirkwood and Morgan, Incorporated's C. H. Dean 1, Jose Maria Gregoria Cobian Survey, flowed 125 million and 7.5 million from 2717-2722 feet and 2807-2815 feet, respectively, open, Completed 2-10-51, TD 5468.

**Victoria County.** The Chicago Corporation's J. A. McFaddin Estate B-9, J. W. Moore Survey, not gauged from 2929-2936 feet and 3400-3410 feet, completed 3-10-51, TD 6500.

### TEXAS DISTRICT 2—NEW GAS PAYS

**Goliad County, Berclair field.** Renwar Oil Corporation et al's McCoy Trust 1, T. Simons Survey, flowed 2.2 million from Frio sand, Oligocene 2203-2205 feet, completed 1-20-51, TD 3574.

**Refugio County, Rooke field.** Plymouth Oil Company's A. D. Rooke et al, J. M. Aldrete Survey, southwest of production, flowed 3.3 million from Vicksburg sand, Oligocene 9020-9032 feet, completed 3-26-51, TD 9036.

### TEXAS DISTRICT 3—NEW OIL FIELD

**Jasper County.** American Republics Cor-

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| Maintenance | | | | |
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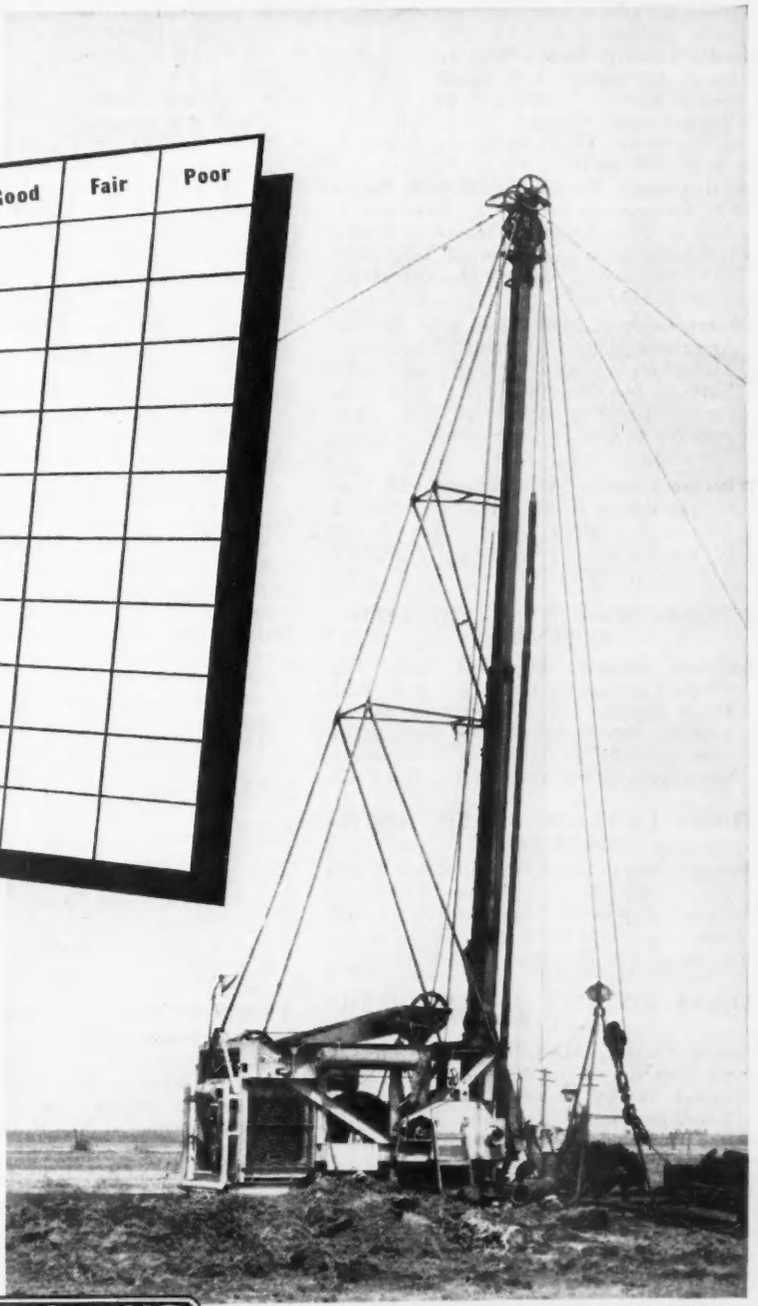

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poration and Houston Oil Company's M. B. Hughes et al 1 Henry Webb Survey, flowed 64 barrels plus 21 barrels water from 6992-6994 feet, 40.5-gravity, 7/64-inch, completed 3-20-51, TD 8103.

### TEXAS DISTRICT 3—NEW OIL PAYS

**Fort Bend County, Long Point Dome field.** Ralph B. Cantrell's M. Pleak 1, Section 102, H&TC Survey, flowed 82 barrels from 5531-5537 feet, 24.3-gravity, 1/8-inch, completed 3-12-51, TD 5576.

**Hardin County, Batson field.** Atlantic Refining Company's Lou Cruse 7, F. H. Green Survey, flowed 174 barrels from Yegua sand, Eocene 5175-5210 feet, 40.7-gravity, 10/64-inch, completed 3-18-51, TD 6002.

**Harris County, Durkee, South field.** Petrex Oil Corporation's Sadie H. Southard 1, George Green Survey, flowed 259 barrels from Look sand, Eocene 7196-7204 feet, 34-gravity, 9/64-inch, completed 3-10-51, TD 8004.

**Liberty County, Moss Bluff field.** British-American Oil Producing Company's McFaddin et al 5, James McFaddin Survey, flowed 155 barrels from Frio sand, Oligocene 5912-5926 feet, 34.5-gravity, 8/64-inch, completed 3-27-51, TD 6355.

**Wharton County, Niels Carlsen field.** Sam G. Harrison's R. B. Wallace 2, Section 14, L. L. Miller Survey, flowed 140 barrels from 5324-5326-feet, 28-gravity, 8/64-inch, completed 3-8-51, TD 7365.

### TEXAS DISTRICT 3—OIL FIELD EXTENSION

**Jefferson County, Big Hill field.** The Texas Company's Crow et al 1, Seth Davis Survey 172, 1¼-mile north extension, flowed 130 barrels from Miocene sand 3602-3613 feet, 37.6-gravity, 9/64-inch, completed 3-8-51, TD 4593.

### TEXAS DISTRICT 3—NEW DISTILLATE FIELD

**Austin County.** Sun Oil Company's Mikeska 1, Stephen F. Austin 4 League Grant, flowed 151 barrels and 1.2 million from 9313-9323 feet, 57.6-gravity, ¼-inch, TD 10,505.

### TEXAS DISTRICT 3—NEW DISTILLATE PAYS

**Austin County, Millheim field.** Gulf Oil Corporation's Fred Palm 1, James Cummings Survey, flowed 121 barrels and 2 million from Wilcox sand, Eocene 10,326-10,340 feet, 54.2-gravity, ¼-inch, TD 11,006.

**Liberty County, Esperson Dome field.** General Crude Oil Company's Esperson C-1, George L. Pace Survey, flowed 50 barrels and 14 million from 8911-8915 feet, 58.2-gravity, completed 3-5-51, TD 11,694.

### TEXAS DISTRICT 3—NEW GAS FIELDS

**Colorado County.** Oil Drilling, Incorporated's Carruth et al 1, Hays, Crawford & Holden Survey, flowed 5.2 million from 8418-8498 feet, open, completed 2-27-51, TD 9936.

**Fort Bend County.** Harold Link et al's Schueneman 1, Section 18, H&TC Survey, flowed 36 million from 4631-4636 feet, completed 3-23-51, TD 4676.

**Wharton County.** Republic Natural Gas Company and Charles H. Osmond's Beck-Rasmussen 2, J. Mitchell Survey, flowed 5.4-million from 2598-2605 feet, open, completed 3-27-51, TD 3222.

### TEXAS DISTRICT 4—NEW OIL FIELDS

**Duval County, "Lopez, North" field.** Magnolia's Duval County Ranch 7, Section 196, Duval County Ranch Survey, flowed 93 barrels from Lopez sand, Eocene 2064-2068 feet, 20-gravity, ½-inch, completed 3-3-51, TD 2105.

**Jim Hogg County, "Agua Neuva de Abajo" field.** Sun Oil Company's A. C. Jones 13, Agua Nueva de Abajo Grant, J. M. Ramirez Survey, flowed 45 barrels from Hockley sand, Eocene 4789-4791 feet, 40.2-gravity, 9/64-inch, completed 3-26-51, TD 4835.

**San Patricio County, "Portland" field.** The Texas Company's Joseph F. Green Estate 1, T. T. Williams Survey, flowed 29 barrels plus 40 barrels water from 9515-9524 feet, 44-gravity, 16/64-inch, completed 3-5-51, TD 11,105.

### TEXAS DISTRICT 4—NEW OIL PAYS

**Jim Wells County, Hollow Tree field.** The Texas Company's H. M. Cornelius 3, SPRR Survey, pumped 85 barrels from 3472-3482 feet, 28-gravity, completed 2-25-51, TD 4302.

**Jim Wells County, Premont, East field.** Magnolia's A. A. Seeligson 182, James H. Houghton Survey, flowed 78 barrels plus 8 barrels water from 5483-5486 feet, 42-gravity, 11/64-inch, completed 3-23-51, TD 6025.

**San Patricio County, Mud Flats field.** Sun's Milton Gabriel 1, Section 55, 6th Subdivision of Taft Farmlands, pumped 12 barrels from 9018-9028 feet, 34.5-gravity, completed 3-2-51. TD 10,015.

**San Patricio County, Portilla field.** Superior's Minnie S. Welder 26, Section 19, Welder Ranch Subdivision, flowed 155 barrels from 8630-8635 feet, 34.3-gravity, 8/64-inch, completed 3-2-51, TD 9000.

### TEXAS DISTRICT 4—OIL FIELD EXTENSION

**Starr County, Jones, East field.** Sun's A. C. Jones-State 1, Antonio Garza Aceveda Survey, 3/4-mile southwest extension, flowed 140 barrels from Hockley sand, Eocene 4619-4627 feet, 46.8-gravity, 9/64-inch, completed 3-8-51, TD 4947.

### TEXAS DISTRICT 4—NEW GAS PAY

**Nueces County, Nueces Bay field.** Erle P. Halliburton Oil Company's State Tract 1-723, Nueces Bay State Tract 723, flowed 11 million from 3764-3768 feet, open, completed 3-8-51, TD 4045.

### TEXAS DISTRICT 4—GAS FIELD EXTENSION

**Hidalgo County, Lacy field.** Hydrocarbon Production Company, Incorporated's Schwarz-Ritcheson 1, Block 24, Capisallo District Subdivision, 1-mile south extension, flowed 5.8 million from Frio "A" sand, Oligocene 7231-7244 feet, open, completed 2-19-51, TD 7545.

### TEXAS DISTRICT 5—NEW OIL PAY

**Kaufman County, Ham-Gossett field.** Thomas D. Humphrey and Son's Annie M. Fritz 1, E. Fitzgerald Survey, flowed 467 barrels from Rodessa lime, Lower Cretaceous 6223-6239 feet, 40.9-gravity, 3/8-inch, completed 3-21-51, TD 6800.

### TEXAS DISTRICT 5 OIL FIELD EXTENSION

**Falls County, Lott field.** E. Fletcher's G. B. Storey 1, R. S. Hunnicutt Survey, 1-mile southwest extension, flowed 201 barrels from Buda lime, Upper Cretaceous 1302-1330 feet, 32-gravity, ½-inch completed 3-20-51, TD 1330.

### TEXAS DISTRICT 6—NEW OIL FIELD

**Wood County.** Morris Palmer Drilling Company & J. M. Deupree's D. Slayton 1, S. Holman Survey, pumped 310 barrels from sub-Clarksville sand, Cretaceous 4194-5004 feet, 28.5-gravity, completed 3-29-51, TD 6465.

### TEXAS DISTRICT 6—DISTILLATE FIELD EXTENSION

**Shelby County, Joaquin field.** Lion Oil Company's G. W. Hanson Estate 1, Mannon Smith Survey, 2-mile northwest extension, flowed 25 barrels and 2.5 million from Pettit lime, Cretaceous 6180-6200 feet, ¼-inch, completed 3-10-51, TD 6250.

### TEXAS DISTRICT 7-B—NEW OIL FIELDS

**Brown County.** Joe Amberson's L. C. Riordan 1, Section 353, C. B. Jennings Survey, 4 miles west of Bangs, pumped 20 barrels from 1182-1188 feet, 42-gravity, completed 3-10-51, TD 1188.

**Eastland County.** A. E. Bradley's Mrs. W. E. Holcomb 1, John House Survey, 2 miles east of Eastland, pumped 15 barrels from Lake sand, Pennsylvanian 3122-3134 feet, 40.2-gravity, completed 2-20-51, TD 3170.

**Eastland County.** Bob Vaught et al's Hightower-Gray 1, Block 4, William Van Norman Survey, 8 miles east of Eastland, pumped 14 barrels from 1174-1183 feet, 37-gravity, completed 3-27-51, TD 1183.

**Fisher County.** Moutray-Moore Drilling Company's J. L. Sharp et al 1, Section 207, BBB&C Survey, flowed 15 barrels from Swastika sand, Pennsylvanian 3813-3820 feet, completed 3-1-51, TD 3841.

**Haskell County.** Anderson-Prichard Oil Corporation's Maude E. Harber 1, Section 145, Block 45, H&TC Survey, 5 miles north of Weinert, pumped 8 barrels plus 4 barrels water from Strawn sand, Pennsylvanian 4680-4689 feet, 40-gravity, completed 3-10-51, TD 5467.

**Jones County.** Taubert Drilling Company's J. W. Tiner 1, Section 14, S. M. Reynolds Survey, 3 miles southwest of Noodle, pumped 85 barrels from Noodle Creek lime, Pennsylvanian 2478-2488 feet, 39-gravity, completed 3-10-51, TD 4311.

**Jones County.** West Central Drilling Company's J. M. Alexander 1, Section 2, Block 14, T&P Survey, 3 miles northeast of Nugent, pumped 90 barrels from 1578-1588 feet, 40-gravity, completed 3-18-51, TD 1588.

**Stephens County.** Gilchrist Drilling Company's Swenson Ranch A-1, Section 37, Block 5, T&P Survey, 6 miles southeast of Breckenridge, pumped 32 barrels from 1924-1929 feet, 40-gravity, completed 3-9-51, TD 2258.

**Stephens County.** F. R. Hanrahan et al's J. C. Thompson 1, Section 86, Block 6, T&P Survey, 3½ miles southwest of Frankell, pumped 11 barrels and 7 barrels water from 2020-2030 feet, 39-gravity, completed 3-23-51, TD 2030.

**Stephens County Sunshine Field.** Bob Sunshine et al's B. C. McNabb 1, Section 67, Block 4, T&P Survey, 14 miles north of Ranger, flowed 161 barrels from Strawn Sand, Pennsylvanian 1880-

# "Why should you be in all parts of the oil business?"

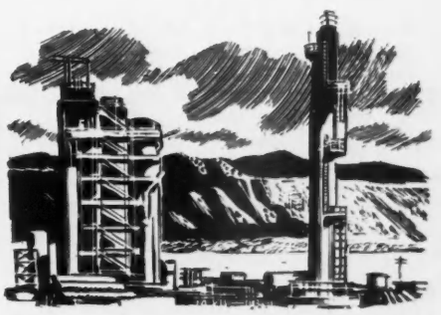
**Mrs. Henry Lincoln, housewife in Boise, Idaho, asks:** *"Do you have to be in all parts of the oil business? Why don't you just produce or refine, and give other companies a chance to do the transporting, selling, etc.?"* Mrs. Henry Lincoln

Why *all* parts? Take the example of how Standard serves Idaho and eastern Oregon. Time was when severe winter weather often delayed deliveries. Costs seemed high. Here was a *need*, a *demand*.

Some 600 miles away in Colorado was a possible source of additional fuel—the old Rangely oil field, long undeveloped. Standard studied the *demand* and the *supply*, decided to bring them together.

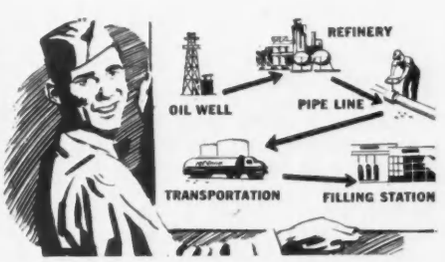
That called for a complete, *integrated* operation—getting the crude out of the ground, refining it, delivering it to users—all carefully planned ahead. So new wells were drilled at Rangely.

And to move the crude. Standard laid a pipeline to Salt Lake City. This called for an especially big investment because the 182 mile long line is the world's highest: crosses the Uinta Mts. at 9560 feet.



Next—a new Standard refinery at Salt Lake City. It cost over $15 million. But to keep costs down, it must operate continuously—have constant supply of crude, constant movement of product.

Another long pipeline was then built on up to the Northwest. Gasoline and fuel oil made from Rangely crude now go where they're needed—lower in cost, plentiful no matter how tough the winter.




If Standard had not been prepared—in *size*, in *integrated skills*, in *investment capital*—to tackle this job as it did, it could not have done this job at all. As it is, we are able to serve a large area *well*.

## *I'd Like to Know . . .*

You may have heard that a suit has been filed by the Antitrust Division in Washington, D. C. to break up Standard of California as well as six other West Coast oil companies. Many people have written us protesting this action, have asked pertinent questions. We believe these questions should be answered for everyone. We take this way of doing so. If you have a question, write:

"I'd Like to Know"
225 Bush Street, San Francisco 20

**STANDARD OIL COMPANY OF CALIFORNIA**

**• plans ahead to serve you better**

1884 feet, 40-gravity, open, completed 3-8-51, TD 1884.

**Stonewall County.** Cities Service Oil Company's Baitz 1, Section 27, BBB&C Survey, 2½ miles east of Old Glory, pumped 24 barrels from Pennsylvanian Conglomerate, 6002-6039 feet, 41-gravity, completed 3-6-51, TD 6130.

### TEXAS DISTRICT 7-B—NEW OIL PAYS

**Jones County, Ball-Kuehn field.** R-H-K Drilling Company Ltd. & Clark & Cowden Drilling Company's R. T. Bennett 1, Block 27, League 149, DeWitt CSL Survey, 1 mile north of production, flowed 205 barrels from Canyon Reef lime Pennsylvanian 4556-4564 feet, 41-gravity, ¼-inch, completed 3-23-51, TD 4646.

**Taylor County, Blair Shallow field.** Drilling and Exploration Company Incorporated's W. C. Bryan 1, Section 73, Block 19, T&P Survey, pumped 20 barrels plus 10 barrels water from Cook lime, Pennsylvanian 2966-2993 feet, 41-gravity, completed 3-22-51, TD 2993.

**Stephens County, Sunshine field.** Robert Sunshine's D. M. Stanford 1, Section 45, Block 6, T&P Survey, pumped 88 barrels from Lower Strawn sand, Pennsylvanian 1984-1990 feet, 41-gravity, completed 3-22-51, TD 1990.

**Stonewall County, Aspermont, South field.** Skelly's J. G. Dalby 1, Section 19, Block D, H&TC Survey, flowed 208 barrels from Canyon sand, Pennsylvanian 4108-4329 feet, 42-gravity, 20/64-inch, completed 3-17-51, TD 6484.

### TEXAS DISTRICT 7-B—NEW GAS FIELDS

**Callahan County.** Fred M. Manning's R. L. Berry 1, (OWDD) Section 70, BOH Survey, 4 miles east of Baird, flowed 1 million from 3462-3472 feet, completed 3-7-51, TD 4282.

**Comanche County.** J. W. Wadley & D. Breeding et al's I. A. Ward Estate 1, Section 19, ETRR Survey, 3½ miles southwest of Sidney, flowed 4 million from Marble Falls lime, Pennsylvanian 2127-2204 feet, completed 3-13-51, TD 2619.

**Parker County.** Thomas W. Doswell & Todd M. Pettigrew et al's W. L. Hudson 1, J. F. Bates Survey, ½ mile east of Brock, flowed 1 million from 2035-2310 feet, open, completed 3-15-51, TD 2310.

### TEXAS DISTRICT 7-B—GAS FIELD EXTENSION

**Hamilton County, Un-named field.** Amerada Petroleum Corporation's Maud S. McEntire 1, Andrew J. Curry Survey, 1-mile north extension, flowed 0.2 million from Marble Falls lime, Pennsylvanian 3195-3285 feet, 1/8-inch, completed 3-5-51, TD 3450.

### TEXAS DISTRICT 7-C—NEW OIL FIELDS

**Runnels County.** Ashmun & Hilliard Oil Company's McCaughan 1, Tract 14, T. M. Fowler Survey, pumped 53 barrels from Jennings sand, Pennsylvanian 4486-4489 feet, 46.6-gravity, completed 3-2-51, TD 4529.

**Runnels County.** C. B. Drilling Company et al's W. M. Ashton 1, H. Garmes Survey, pumped 42 barrels from Swastika sand, Pennsylvanian 2531-2533 feet, 43.5-gravity, completed 3-10-51, TD 2550.

**Runnels County, "Patsy" field.** C. B. Drilling et al's Garland Nunn 1, H. Garmes Survey, flowed 102 barrels from Serratt sand, Pennsylvanian 2523-2524 feet, 44-gravity, 15/64-inch, completed 3-16-51, TD 2524.

**Runnels County.** Humble's Ray Tyree 1, B. G. Hall Survey, pumped 19 barrels from Goen lime, Pennsylvania 4206-4217 feet, 50.3-gravity, completed 3-26-51, TD 5281.

### TEXAS DISTRICT 7-C—NEW OIL PAYS

**Runnels County, Ft. Chadbourne field.** Skelly's Otto Tuerk 1, Alfred Howell Survey, flowed 83 barrels from Gardner sand, Pennsylvanian 5132-5149 feet, 41-gravity, 18/64-inch, completed 3-8-51, TD 5155.

**Runnels County, Winters field.** Bouchard & Callihan Oil Company's J. S. Brown 1, F. J. Ford Survey, flowed 250 barrels from Caddo lime, Pennsylvanian 4498-4503 feet, 46.8-gravity, 32/64-inch, completed 3-3-51, TD 4505.

### TEXAS DISTRICT 7-C—NEW GAS FIELD

**Crockett County.** Humble's Cox et al 1-D (OWWO), Section 4, Block QR, GC& SF Survey, flowed 3 barrels and 2.8 million from 7300-7310 feet, 55-gravity, 21/64-inch, completed 3-28-51, TD 8203.

### TEXAS DISTRICT 8—NEW OIL FIELDS

**Cochran County.** Blackwood & Nichols Oil Company's Dean 1, League 91, Lipscomb CSL Survey, flowed 338 barrels from San Andres lime, Permian 5012-5028 feet, 32-gravity, 2-inch, completed 3-13-51, TD 5058.

**Crane County, Mayberry-Connell field.** Cabot Carbon Company's J. B. Mayberry 1, Section 3, Block 31, H&TC Survey, pumped 18 barrels from Connell sand, Pennsylvanian, 5133-5137 feet, 40-gravity, completed 2-26-51, TD 5335.

### TEXAS DISTRICT 9—NEW OIL FIELDS

**Archer County.** McElroy Ranch Company & G. E. Kadane & Sons et al's L. F. Wilson Estate 1, Section 32, ANCL Survey, 6 miles southeast of Holliday, pumped 51 barrels from Strawn sand, Pennsylvanian 3811-3820 feet, 42-gravity, completed 3-7-51, TD 3820.

**Archer County.** Wayne Freeman Jr's. J. M. Bloodworth 1, M. Cartwright Survey, 4 miles north of Olney, flowed 924 barrels from Mississippian lime, 5118-5146 feet, ½-inch, completed 3-6-51, TD 5144.

**Archer County.** W. F. Palmer and H. F. Snebold's Charles Meurer 1, Lot 99, Block 4, Clark & Plumb Subdivision, pumped 5 barrels plus 3 barrels water from Strawn sand, Pennsylvanian 3529-3534 feet, 41-gravity, completed 2-24-51, TD 3534.

**Archer County.** Harry F. Snebold et al's W. T. Wells 1, R. Neil Survey, 1 mile northeast Holliday field, pumped 80 barrels plus 4 barrels water from Vogtsberger sand, Pennsylvanian 4632-4650 feet, 41-gravity, completed 3-23-51, TD 4650.

**Clay County.** Stephens Petroleum Company's Bryant Edwards 1, Section 7, T&NO Survey, 2 miles west of Bryant field, flowed 307 barrels from Simpson lime, Ordovician 6227-6251 feet, 44-gravity, 3/4-inch, completed 3-15-51, TD 6597.

**Jack County.** Texas Canadian Oil Corporation's M. M. Garrett A-1, BBB&C Survey, 2½ miles northwest of Antelope, flowed 162 barrels from Strawn sand, Pennsylvanian 3038-3043 feet, 39-gravity, 10/64-inch, completed 3-17-51, TD 5737.

**Young County.** Warren Oil Corporation's O. D. Swanzy 1, TE&L Survey, ½ mile east of Olney, flowed 154 barrels from Mississippian lime, 4900-4918 feet, 42-gravity, 16/64-inch, completed 3-17-51, TD 4952.

### TEXAS DISTRICT 9—NEW OIL PAY

**Young County, Anzac-Graham field.** Maynard and Maynard's Allar Company 4, A. Hines Survey, 3/4-mile north of production, pumped 19 barrels from Caddo lime, Pennsylvanian 3616-3636 feet, 38.9-gravity, completed 3-19-51, TD 3646.

### TEXAS DISTRICT 9—OIL FIELD EXTENSIONS

**Jack County, Wolfe field.** J. C. Jennings, Wheeler and Ingram et al's J. R. Clayton 1, Block 3333, TE&L Survey, 1½ miles northwest extension, flowed 364 barrels from Upper Caddo lime, Pennsylvanian 4502-4518 feet, 43-gravity, 16/64-inch, completed 3-10-51, TD 4685.

**Wise County, Springtown field.** Kingwood Oil Company's J. H. Peel 1, A. Hargus Survey, 1½ miles northeast extension, pumped 183 barrels from Caddo lime, Pennsylvanian 3811-3818 feet, 40-gravity, completed 3-3-51, TD 3938.

### WYOMING—NEW OIL FIELD

**Big Horn County.** Pond Petroleum Company's Government 1, SE SE NW 12-51n-93w, pumped 40 barrels from Madison lime, Mississippian 3812-3991 feet, completed 2-22-51, TD 3991.

### WYOMING—NEW OIL PAYS

**Johnson County, Meadow Creek "A" field.** Continental Oil Company's Unit 50, NW NW SW 2-41n-78w, flowed 144 barrels from Sussex sand, Upper Cretaceous 4322-4359 feet, ¼-inch, completed 3-5-51, TD 4359.

**Johnson County, Meadow Creek, East field.** American Liberty Oil Company's W. P. Irvine 1, SW SE NE 18-41n-77w, 1½-miles southeast of production, pumped 18 barrels from Wall Creek sand, Upper Cretaceous 6412-6448 feet, TD 7820.

**Natrona County, "Teapot Dome, East" field.** Trigood Oil and Midland Oil Company's Government 1, C NE SW 24-38n-78w, pumped 53 barrels from Dakota sand, Cretaceous 5603-5619 feet, TD 5619.

### WYOMING—OIL FIELD EXTENSIONS

**Big Horn County, Byron, South field.** Lowell & Gist et al's Keele 1, NE SW 32-55n-96w, ½-mile south extension, flowed 80 barrels from Frontier sand, Upper Cretaceous 2796-2840 feet, TD 2840.

**Washakie County, Slick Creek field.** General Petroleum Corporation's Government 44-34, SE SE NW 34-47n-92w, 1½-mile east extension, flowed 410 barrels from Embar lime, Permian, 10,395-10,553 feet, ¼-inch, completed 3-7-51, TD 10,553.

# Thin Oil Column Completions

By R. G. LOPER

Assistant Professor of Petroleum Engineering
Louisiana State University, Baton Rouge

**STUDIES OF completions in zones where the oil lies adjacent to gas and/or water, without intervening impervious formations, are reported herein by the author, who offers recommendations looking toward successful completion practices. Actually a review of about 16 case histories, the article suggests additional drill-stem testing before completion, and puts forward the use of shaped charges for perforation. The article is substantially as presented before the Spring Meeting, Southwestern Division of Production, API, held at Beaumont in March, 1951.**

A PART of the great reserve that lies in the Louisiana and Mississippi Gulf Coast area would remain untapped except for the completion of wells in thin oil columns. A general definition of a thin oil column is an oil zone within a producing horizon and adjacent to gas and/or water without intervening impervious formations, and of a thickness that will not permit a ready selective production of oil. Included herein are descriptions of certain wells which were completed in such columns and the conclusions of the API subcommittee appointed to study thin oil column completions.

### Analysis of Completions

The well logs presented in Figures 1 through 16 are typical examples which will be discussed separately. If centralizers and scratchers were used in the completion of a well, it will be indicated in the description of the completion. The original gas-oil and oil-water contacts are indicated if they were known. These contacts were picked from core analysis, electric logs, or from the original contacts in nearby wells.

It is not the intent of the writer to disagree with certain completion practices or equipment, but to suggest a better method of completion in order to obtain more satisfactory results with the minimum amount of trouble.

The well represented in Figure 1 was drilled to a total depth of 11,204 feet and cemented with 1000 sacks of cement. The casing was perforated from 11,152 to 11,157 feet and squeezed with 75 sacks of cement with a maximum and final pressure of 5000 pounds per square inch. There was no production found at this depth and the well was plugged back to 10,080 feet. Ten ½-inch perforations were made at 10,058 to 10,062 feet and a block squeeze was made with 190 sacks of cement with a final pressure of 4200 psi. Another block squeeze was made through the same number of perforations from 10,024 to 10,026 feet. This latter squeeze required three stages; the first with 170 sacks resulting in a final pressure of 2500 psi, the second with 200 sacks with a final pressure of 1000 psi, and the third with 195 sacks with a final pressure of 4200 psi. The cement was then drilled out to 10,050 feet and perforations were made for production from 10,040 to 10,045 feet with eight ½-inch holes per foot. A perforated nipple was set below a hookwall packer and the completion gauge was 210 barrels of 40.6 API

gravity oil per day with no show of water and a gas-oil ratio of 1094 to 1.

The well was reworked after producing a total of 71,136 barrels of oil because of an excessive gas-oil ratio and mechanical trouble. The perforations were squeezed with 73 sacks of cement with a final pressure on the squeeze of 4800 psi. The cement was again drilled out to a depth of 10,050 feet and the well was perforated for production from 10,047 to 10,049 feet with four ½-inch holes per foot. The well was completed in February making 204 barrels of pipe line oil per day, with a gas-oil ratio of 967 to 1. By September of the same year, production had dropped to 97 barrels per day and 5 percent water, with a gas-oil ratio of 11,296 to 1. The perforations from 10,047 to 10,049 feet were squeezed with 105 sacks of cement with the squeeze pressure building up to a maximum and final pressure of 4500 psi. The casing was perforated from 10,049 to 10,052 feet with ten holes resulting in a production of 178 barrels of pipe line oil per day, with a gas-oil ratio of 761 to 1. The gravity of the crude was 42.2 corrected. After one month's production, the gas-oil ratio increased to 4013 to 1 with no show of water. The cumulative production from this well for a 2½-year period was 179,404 barrels.

This is a good example of the proper technique to be followed in the event that the casing was not equipped with centralizers and scratchers. However, the squeeze above the gas-oil contact is entirely too high to serve the purpose of shutting off the gas. The procedure followed in perforating successively lower in the hole could result in continued high gas-oil ratios because the old production perforations may not be completely sealed as will be shown later herein.

In Figure 2, perforations were made for a squeeze from 9425 to 9430 feet with ten ½-inch holes. Mechanical troubles developed after a total of 35 sacks of cement had been squeezed into the formation under a pressure of 1900 psi. Perforations were again made at the same depth and the squeeze was made in six stages. The first was with 100 sacks with a final pressure of 350 psi; the second, third, fourth, and fifth were with 150 sacks with pressures of 1600, 200, 1200 and 1300 psi, respectively; and the sixth was with 110 sacks with a final pressure of 5800 psi. The section from 9416 to 9418 feet was perforated and squeezed with 90 sacks with a final pressure of 5600 psi. Three feet were perforated with 24 ½-inch holes from 9417 to 9420 feet and tested for production. The well flowed at the rate of 80 barrels of pipe line oil per day with a gas-oil ratio of 923 to 1. After four years the well had produced a total of 47,555 barrels of oil, at which time the water cut had increased to 65 percent and the gas-oil ratio had increased to 10,667 to 1.

The well was reworked to make a gas well because of the high gas-oil ratio, water, and a ready market for the gas. After squeezing the production perforations with 150 sacks of cement to a pressure of 4400 psi, 15 feet of gas sand were perforated with six shots per foot from 9370 to 9385 feet. The well was tested and shut in for two months at which time the gauge was 190 barrels per day at a gas-oil ratio of 16,947 to 1 with 0 percent water.

The total production from the well in five years was 57,037 barrels of distillate.

The lower section was depleted as indicated by the increased water production before the workover.

### Using Centralizers, Scratchers

In Figure 3, centralizers and scratchers were used in completing at 6918 feet. The temperature survey found the top of the cement at 5874 feet, while the calculated height with 260 sacks of cement indicated the cement should have been found at a depth of 6289 feet. Perforations for plastic squeeze and production were made from 6915 to 6918 feet with 12 holes per foot. The plastic consolidation was made in two stages using 100 gallons of plastic for each stage. Both stages required 2500 psi to squeeze the plastic into the formation. The well was completed using a hookwall packer. The completion gauge was 163 barrels of pipe line oil per day, with a gas-oil ratio of 853 to 1.

Two months later the well bridged with plastic and sand necessitating a workover. The same producing perforations were squeezed with 200 gallons of mud acid which was followed by a two-stage plastic squeeze. Again 100 gallons for each stage were used with final squeeze pressures of 1350 psi for the first stage and 1150 psi for the second stage. The same type of production completion was made and the completion gauge indicated 130 barrels of oil per day, with 1/10 percent bottom sediment and water and a gas-oil ratio of 1120 to 1. Approximately one year later the individual gauge was 205 barrels of pipe line oil per day, with a gas-oil ratio of 590 to 1. In all the tests the gravity

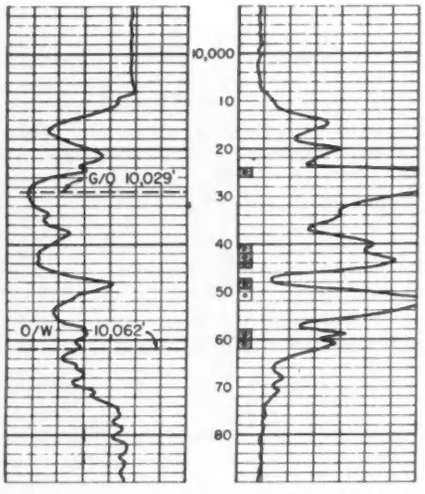



FIGURE 1. Example of block squeeze.

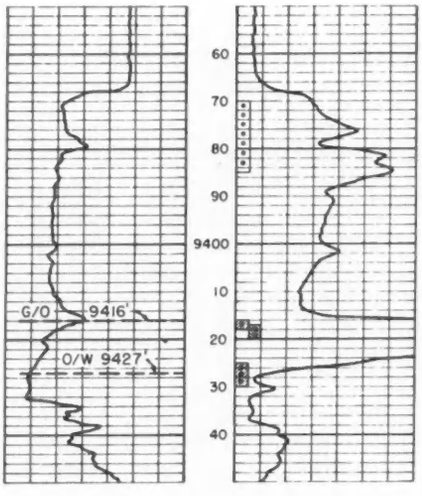



FIGURE 2. A channeled cement job.

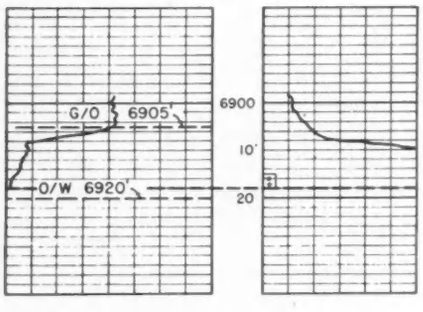



FIGURE 3. Minimum completion distance above oil-water contact.

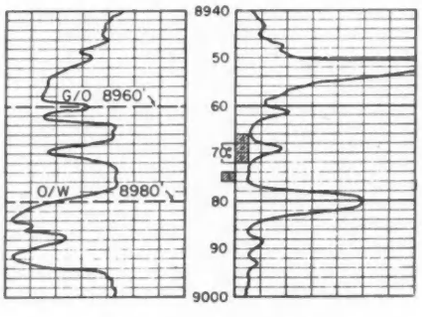



FIGURE 4. Gas channeling.

of the oil remained at approximately 41 API corrected.

The total production at the last gauge was 109,736 barrels with no appreciable water production, even though the producing perforations were only two feet above the oil-water contact. The gas-oil ratio remained low as a result of perforating in the lower part of the producing sand. This completion gives some indication as to the minimum distance above the water that a well may be completed, and also indicates the advantage of using centralizers and scratchers to eliminate block squeezes to insure a good cement job.

In Figure 4, the well was cemented without centralizers and scratchers at a depth of 9707 feet with 1000 sacks of cement. The casing was perforated from 8974 to 8976 feet with ten ½-inch holes for a block squeeze. Two hundred seventy-five sacks were squeezed with a final pressure of 4500 psi. Perforations for test were made with 48 ½-inch shots in the section from 8966 to 8972 feet. The resulting drill-stem test was 185 barrels of oil per day with 1/10 percent bs&w, and at a gas-oil ratio of 577 to 1. A hookwall packer setting was made and, when tested, made gas with a small amount of distillate. These perforations were squeezed in three stages with 150 sacks of cement being used for each stage. The pressures recorded for the first two stages were 2600 psi, and 5000 psi for the last stage. A completion gauge was then made after perforating from 8968 to 8972 feet with 11 ½-inch holes. The gauge was 271 barrels per day through a ⅛-inch choke with 1/10 percent bs&w and a gas-oil ratio of 453 to 1. Gravity of the crude was 36.6 API corrected. The last individual gauge taken three years later was 99 barrels per day with 10 percent bs&w and an increase in gas-oil ratio to 9545 to 1. Cumulative production for the three-year period was 85,837 barrels of oil.

From the test record, it is indicated that on the first completion there was a channel at the shale break and gas was coming from above.

In Figure 5, perforations were made from 8978 to 8983 feet with two holes per foot for a squeeze to insure the shut off of bottom water. The squeeze was completed with 490 sacks of cement being pumped into the formations with a final pressure of 3600 psi. A drill-stem test of perforations from 8956 to 8970 feet with 56 ½-inch holes yielded 82 barrels of pipe line oil with a gas-oil ratio of 16,750 to 1. The perforations were squeezed with 590 sacks of cement and the final and maximum pressure was 5200 psi. The third perforations were made from 8955 to 8976 feet with two ½-inch holes per foot and squeezed at 5100 psi with 560 sacks of cement. The next set of perforations for production were made from 8968 to 8976 feet with four ½-inch holes per foot and tested 86 barrels of pipe line oil per day with a gas-oil ratio of 2541 to 1. After completion, the gauge was 119 barrels per day with 1/10 percent water and a gas-oil ratio of 2500 to 1. After producing for eight years, the gauge was 109 barrels per day with 55 percent bs&w and the gas-oil ratio had decreased from 2500 to 1 to 843 to 1. The cumulative production for the period indicated was 350,101 barrels of 39-gravity oil.

The first perforations for test were made well into the shale and gas cap, as indicated by the log and the high gas-oil ratio.

After deepening and setting liner, perforations were made from 5681 to 5683 feet for a two-stage squeeze (Figure 6). The formation was broken down with a pressure of 2000 psi before squeezing 210 gallons of resin cement with a maximum pressure of 2000 psi and a final pressure of 1750 psi. The second stage was squeezed with the same amount of cement but the breakdown pressure was 1200 psi, the maximum pressure was 2150 psi, and the final pressure was 1200 psi. The second stage was tested at a pressure of 1500 psi before perforating for a squeeze from 5660 to 5662 feet. The first two stages were each squeezed with 310 gallons of resin cement. The first stage had breakdown, maximum, and final pressures of 1200, 1400 and 1200 psi, respectively. The second stage pressures were 1300 psi breakdown, and a maximum and final pressure of 1600 psi. The third stage was squeezed with 95 sacks of slow-set cement with a breakdown pressure of 1200 psi and the maximum and final pressure was 2000 psi. Stage 4 was squeezed with 95 sacks of 2 percent bentonite cement with breakdown, maximum and final pressures of 1400, 2200 and 2000 psi. Production perforations were made from 5662 to 5668 feet with six ½-inch holes per foot. Production from these perforations was 67 barrels per day with 44 percent wash water at a producing gas-oil ratio of 1970 to 1.

The well sanded up nine months later, at which time the packer and tubing were pulled and reset. At the end of the first day after being placed on production the well had sanded

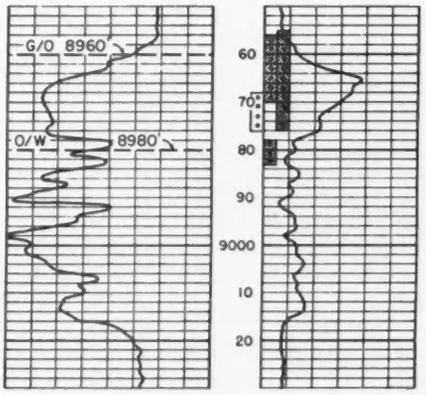



FIGURE 5. Failure to recognize gas-oil contact.

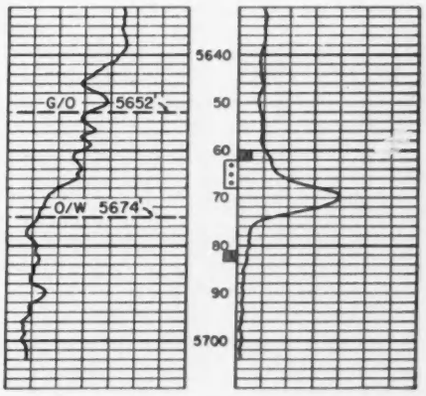



FIGURE 6. Use of plastic opposite transition zone.

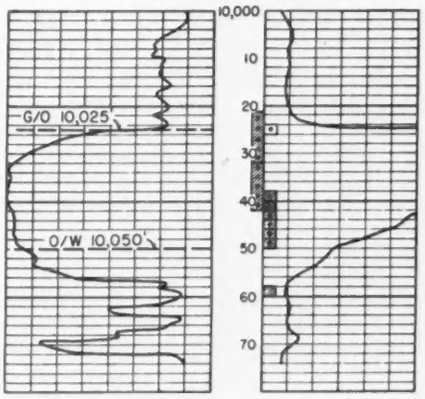



FIGURE 7. Perforated at gas-oil contact.

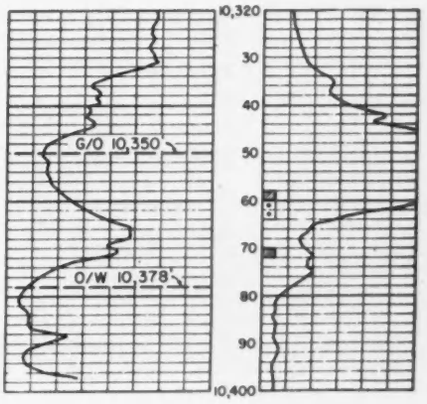



FIGURE 8. A block squeeze completion.

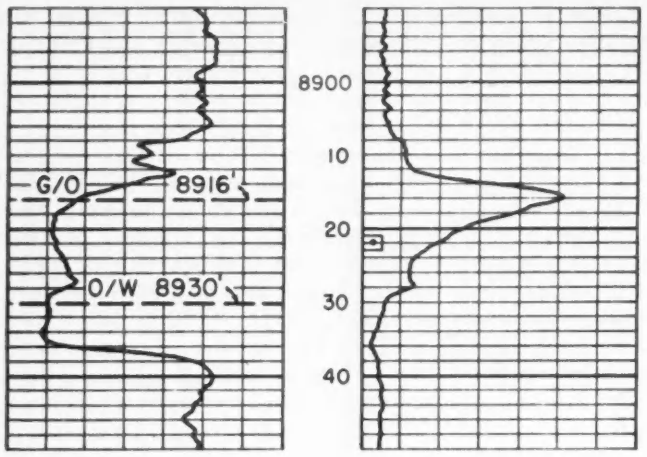



FIGURE 9. Completion through original perforated section.

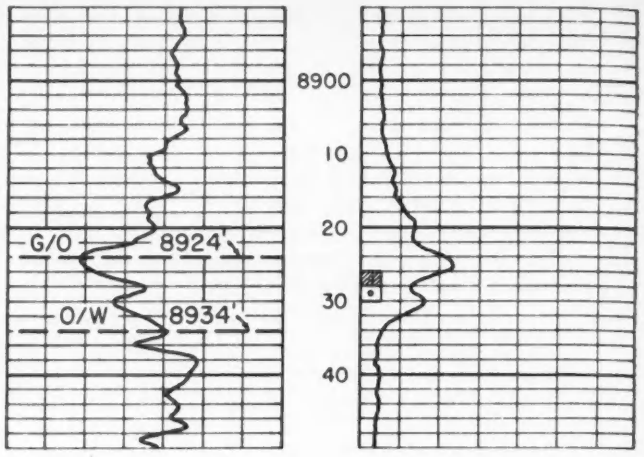



FIGURE 10. Minimum completion distance below gas-oil contact.

up. The producing perforations were squeezed with permeable plastic using 125 gallons for the first two stages and 150 gallons for the third. The first stage had a maximum pressure of 750 psi and final of 0 psi. The second stage reached a final pressure of 250 psi. After breaking down the formation with 700 psi, the last stage was squeezed with a maximum pressure of 800 psi and a final pressure of 400 psi. Upon testing, the well would not flow. It then swabbed 20 to 30 percent sand. Another 150 gallons of plastic was squeezed into the formation, requiring a maximum pressure of 800 psi and a final pressure of 250 psi. The tubing with gas-lift valves was reset with a hookwall packer. The well came in making 98 percent water but within five days had cleaned itself and was producing at the rate of 49 barrels of oil per day with no water or sand.

Within a month's time the well had again sanded up. After cleaning out, 32 ½-inch holes were shot from 5662 to 5668 feet for a gravel pack. The pack was made in the following order: first, eight sacks of fine gravel were squeezed into the formation; second ⅛ sack of 0.187 to 0.250 coarse gravel and 7¾ sacks of 0.04 to 0.06 fine gravel were squeezed out; and, third, 9¼ sacks of fine gravel was squeezed through the perforations. During the gravel pack, the maximum pressure recorded was 1500 psi and the final pressure was 400 psi. The gauge upon completion was 16 barrels per day on gas lift with 50 percent water. The last individual well gauge, made seven months after the last workover, was 120 barrels of 37.2-gravity oil flowing with a gas-oil ratio of 900 to 1. The cumulative production to this date was 39,100 barrels of oil.

The failure of the consolidating plastic would certainly have been expected, since most of the perforated interval was opposite the sand-shale transition zone.

Referring to Figure 7, production was obtained from lower sands before plugging back to the present zone. Two feet were perforated with ten holes from 10,058 to 10,060 feet and squeezed with 90 sacks of cement at a maximum and final pressure of 5000 psi, after breaking down the formation with 3800 psi. Test perforations were made at a density of four holes per foot from 10,020 to 10,032 feet and tested gas and distillate. Perforations were again made without a squeeze from 10,032 to 10,042 feet with the same perforation density. Production from these perforations was 248 barrels of pipe line oil per day with a gas-oil ratio of 1150 to 1. The gauge, after completing, was 105 barrels of oil per day with 50 percent water and a gas-oil ratio of 20,604 to 1. Due to the high gas-oil ratio, the perforations were squeezed with 35 sacks of cement at a maximum and final pressure of 2200 psi. The cement was drilled out to 10,034 feet and squeezed with 250 gallons of non-permeable plastic. The breakdown pressure was 2900 psi, the maximum 3500 psi, and the final 2900 psi. The plastic squeeze was repeated, after drilling out to 10,034 feet, with 250 gallons after breaking down the formation with 2900 psi and building up to a maximum and final pressure of 3500 psi. The plastic was drilled out and production perforations made from 10,038 to 10,042 feet with 48 holes. A drill-stem test indicated 122 barrels per day with 1/10 percent bs&w and a gas-oil ratio of 4390 to 1. The casing was cleaned out to 10,051 feet and perforated from 10,038 to 10,050 feet with six holes per foot. The test from the last perforations was 225 barrels per day with 1/10 percent water and the gas-oil ratio was reduced to 1870 to 1. A screen setting was made and the completion gauge was 194 barrels per day with 5 percent cut and a gas-oil ratio of 4983 to 1. Production continued for a period of three years at which time the well went dead and was swabbed in, but required the installation of flow valves before any more production was obtained. After three months on gas lift, production had dropped to 18 barrels of oil and 890 barrels of water per day. The production perforations were squeezed and the casing was perforated from 10,024 to 10,026 feet. The completion gauge indicated 103 barrels per day with 97 percent bs&w on gas lift. The cumulative production for four years was 149,509 barrels.

It is to be noted that these latter perforations had tested gas in the early history of the well but, upon depletion of the lower zone, gave a water cut of 97 percent. This would have been expected due to the continued high gas-oil ratio during the production of the lower section. The well had an original gas-oil contact well above the perforations from 10,038 to 10,050 feet, but it was either indicated to be in error as a result of the tests or the contact from the core analysis was correct and the squeeze jobs were not successful. In either case, one more squeeze operation to reduce the gas-oil ratio would not have been excessive in view of the fact that there had been numerous squeezes in an attempt to complete the well. In any event, the well should have never been perforated at the gas-oil contact. The early production of water was to be expected since the lower perforations were made at the oil-water contact.

### Block Squeeze Completion

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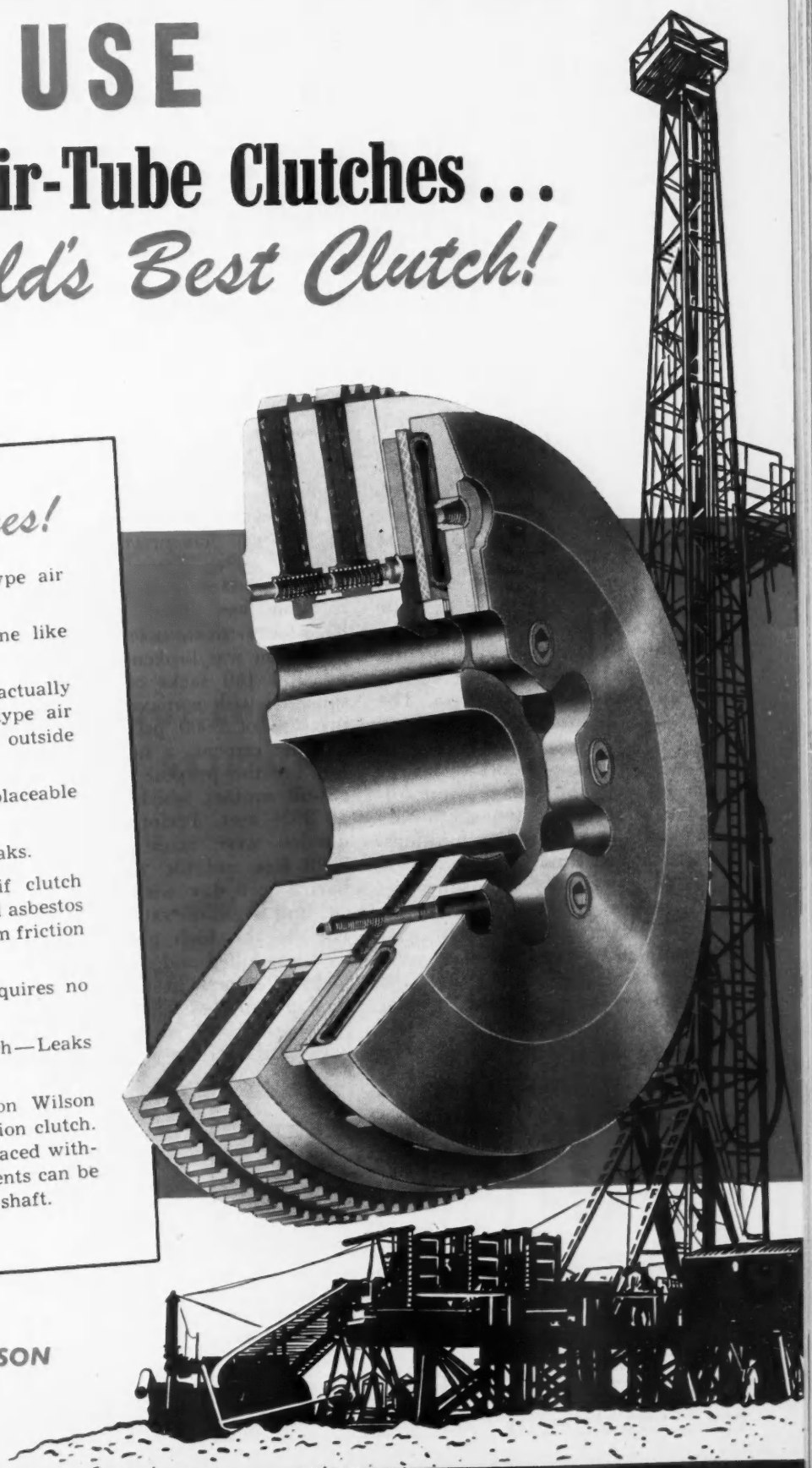

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production (Figure 8). The lower squeeze was made through eight ½-inch perforations from 10,370 to 10,372 feet with 50 sacks of cement which required 3900 psi to break down the formation and a final and maximum pressure of 5200 psi. The upper squeeze was completed with 70 sacks of cement with a maximum and final pressure of 5300 psi in the section 10,358 to 10,360 feet which was perforated with eight ½-inch holes. The cement was drilled out to 10,370 feet and the casing perforated from 10,360 to 10,364 feet with six ½-inch holes per foot. The completion gauge showed 246 barrels of pipe line oil per day with a gas-oil ratio of 732 to 1. After producing 20 months, the well was still producing at a rate of 64 barrels per day with a gas-oil ratio of 1796 to 1 but the water production had increased to 80 percent.

This is a good method of completion where high gas-oil and/or water-oil ratios are to be expected in thin oil column completions.

The well in Figure 9 was first perforated from 8921 to 8923 feet with 12 holes and squeezed in four stages. The first stage required 2200 psi to break down the formation, and the 150 sacks of cement were squeezed with a maximum pressure of 3200 psi. On the second squeeze, the formation broke down with 2200 psi and 100 sacks were squeezed out with a maximum pressure of 4800 psi. The next stage required a breakdown pressure of 4100 psi and a final pressure of 4200 psi to squeeze out 75 sacks. The first three stages were followed with approximately seven barrels of water to clear the perforations. The fourth and final stage was made by mixing 100 sacks and squeezing out 90 sacks. The breakdown pressure was 5500 psi and the final pressure was 5200 psi. Perforations were made in the same section with the same number of shots after drilling out the cement. The results of the test were 216 barrels of oil per day with a gas-oil ratio of 1138 to 1.

The completion practice followed in this well has proved highly successful.

Referring to Figure 10, squeeze perforations were made from 8926 to 8928 feet with six holes per foot. The formation was broken down at 1600 psi and 160 sacks of cement were squeezed with a maximum and final pressure of 5000 psi. After drilling out the cement, a neutron log was run for the purpose of picking the gas-oil contact which was indicated at 8924 feet. Perforations for production were made from 8926 to 8928 feet and the well flowed 167 barrels per day with 1/10 percent cut and a gas-oil ratio of 3444 to 1. Due to the high gas-oil ratio, the well was killed and squeezed with 50 sacks of cement at a maximum and final pressure of 5200 psi. The next perforations were made two feet lower with 12 shots from 8928 to 8930 feet. The initial production was 173 barrels per day with 3/10 percent cut and a gas-oil ratio of 2329 to 1. There was no increase in gas-oil ratio until the well had been on production for six months. The last well gauge was 108 barrels per day with a gas-oil ratio of 7194 to 1 and a slight reduction in the initial water cut.

The first test indicated that the perforations were too close to the gas-oil contact, and that the lowering of the perforations indicated that the critical distance between the gas-oil contact and the top of the perforations should be between two and four feet.

The well represented by Figure 11 was cemented with 500 sacks with rotary scratchers and centralizers on the bottom joint. Initial perforations from 3402 to 3404 feet were squeezed in two stages with 200 sacks being used for each stage. The breakdown pressure recorded for the first stage was 2900 psi with subsequent maximum pressure of 2200 psi and a final pressure of 800. The second stage required a pressure of 1900 psi to break down the formation and a maximum pressure of 1500 psi was required to squeeze 185 sacks with a final pressure of 700 psi. The well was completed by perforating at the same level and flowed 200 Mcf of gas and 20 barrels of oil per day. The production perforations were squeezed with 85 sacks of cement with a maximum pressure of 2500 psi being reached after the initial breakdown pressure of 2200 psi. The final pressure after the squeeze was 2100 psi. The shoe was drilled out to a total depth of 3407 feet and perforations made from 3405 to 3406 feet with shaped charges. Initial production was 58 barrels per day with a cut of 6 percent and gas-oil ratio of 998 to 1.

This completion indicated that the minimum distance between the top of the perforations and the gas-oil contact is approximately four feet.

Total depth of the well referred to

## About the Author

R. G. LOPER, assistant professor of petroleum engineering at Louisiana State University, Baton Rouge, received a B.S. in 1947 and an M.S. in 1949 from the University of Oklahoma, where he also was an instructor for some time. In the U. S. Army Field Artillery during World War II he attained the rank of captain.

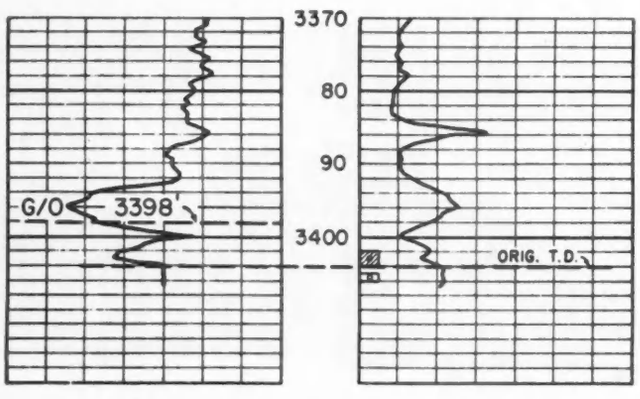


FIGURE 11. Minimum completion distance beolw gas-oil contact.

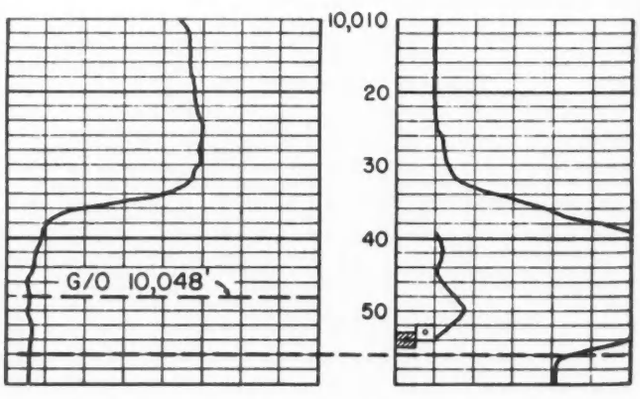


FIGURE 12. Failure to recognize oil-water contact.

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in Figure 12 was 10,056 feet with initial perforations from 10,053 to 10,055 feet. First, 40 sacks of cement were squeezed with a maximum and final pressure of 5500 psi after breaking down the formation with 3000 psi. The well was reperforated at the same depth and came in making water. Thirty-five more sacks were squeezed with the breakdown pressure recorded as 3200 psi and the maximum and final pressure as 5200 psi. Two feet were perforated from 10,052 to 10,054 feet and the well came in making pipe line oil but turned to water. The formation was broken down at 4400 psi and was washed with 250 gallons of mud acid which went in on a vacuum. Ten sacks of cement were then squeezed with a final and maximum pressure of 5700 psi. The well was again perforated from 10,052 to 10,054 feet and on the initial production test made 78 barrels of oil per day with 60 percent water cut and a gas-oil ratio of 985 to 1. The water cut and gas-oil ratio increased to 80 percent and 1900 respectively, with 90 barrels of oil being produced per day.

The final completion and the electric log indicate that the oil-water contact was at or near 10,053 feet, and better results might have been obtained by perforating only one foot instead of the two that were used in this completion.

The well referred to in Figure 13 was perforated for test from 5092 to 5100 feet with 48 ½-inch shots. The well was swabbed for 12 hours with the packer set at 5064 feet with only a show of oil and gas. A second set of perforations were made from 4996 to 5008 feet and from 5081 to 5086 feet with six ½-inch shots per foot. A packer was set at 4975 feet and the well was swabbed 18 hours at the rate of 150 barrels per day. The fluid was 98 percent water. The perforations from 5081 to 5086 feet and from 5092 to 5100 feet were squeezed at the same time with 140 sacks of cement with a final pressure of 2000 psi. The remaining open perforations were then tested by swabbing with the recovery being 99 percent salt water. A two-stage squeeze was then made with 285 sacks of cement for the first stage with a final pressure of 3000 psi, and 280 sacks were used for the second stage with a final pressure of 3200 psi. The well was again swabbed after reperforating from 4996 to 5008 feet with six ½-inch shots per foot, and the fluid recovered was 100 percent water. After the results of the last test, the well was abandoned.

The lower perforations had little chance of producing because of the high water and low oil saturation. The middle and upper stringers may have had some recoverable gas or oil, as indicated by the low residual liquid content given by the core analysis. However, failure to squeeze the thin sections before testing could have been the cause of the high water-oil ratios. Further, the upper section at 4996 to 5008 definitely has an oil-water contact, while the entire section was opened to perforations. Based on the electric log and core analysis the sands do not appear to have much possibility for production; but, in many instances, appreciable reserves have been passed up by improper completion practices.

In Figure 14, the well was cemented at 8260 feet using centralizers and scratchers. The well was plugged back to 8232 feet and perforated for test from 8170 to 8180 feet with 60 ½-inch holes. The initial production was 18.96 barrels of 50.8-gravity distillate and 3183 Mcf of gas per day with 6/10 percent bs&w. With these perforations open, another section from 8108 to 8127 feet was perforated with 114 ½-inch holes. After the well was washed and then swabbed down 500 feet, it kicked off and produced 18 barrels of 51.0-gravity distillate and 3545 Mcf of gas per day with 2/10 percent water. Production continued from this setting for two years, at which time the well was reworked because of excess water production. The lower perforations were tested and found to be making 95 percent water. These perforations were squeezed and the well plugged back to 8150 feet. The upper perforations tested dry and the section was reperforated with 76 ½-inch shots and resulted in a flow of 25.2 barrels of 52.1-gravity distillate and 2960 Mcf of gas per day with 3 percent bs&w. The initial production, after setting a packer and swabbing, was 15 barrels of 52.1-gravity distillate and 2064 Mcf of gas per day. The total production from these two sections at the time of the last test was 9217 barrels of distillate, 1,534,304 Mcf of gas and 45,115 barrels water.

The results of the tests on the perforations indicate that there was no penetration in the upper section with the first perforation. It is suggested that, in the event two sections are open to perforations, both sections should be drill-stem tested before completion.

In the well referred to by Figure 15, four separate attempts at penetration were made with a total of 69 ½-inch shots in the section from 6629 to 6632 feet. After each attempt to perforate with ½-inch shots, tests were run and all tested dry except the fourth, which had a recovery of 2.56 barrels of distillate and 86,523 cubic feet of gas with a 2 percent cut. Perforations were made for a test from 6448 to 6454 feet with 36 ½-inch shots and with both sets of perforations open, tested 3.8 barrels of distillate and 88,787 cubic feet of gas with 60 percent water per hour. A two-stage squeeze was made on the lower perforations with 150 sacks being squeezed on the first stage with a final pressure of 1800 psi, and 50 sacks being squeezed on the second stage with a final pressure of 1900 psi. The

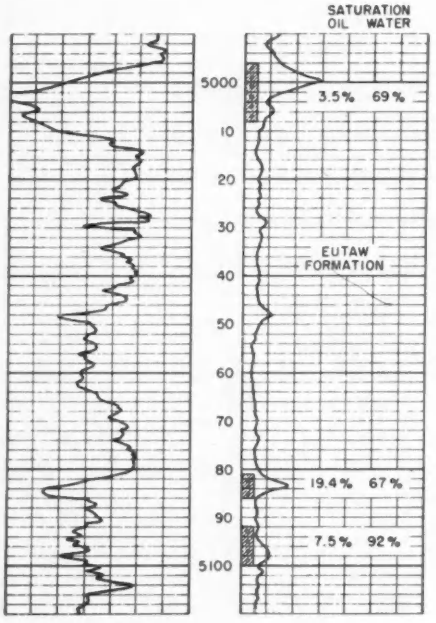


FIGURE 13. Failure to squeeze before completion.

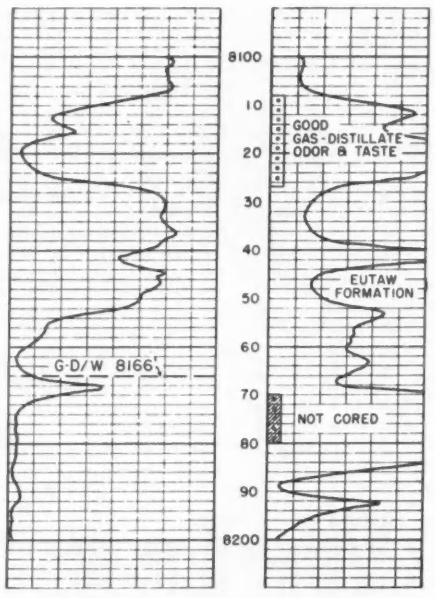


FIGURE 14. Plugged perforations.

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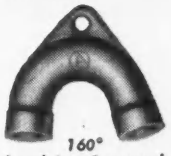

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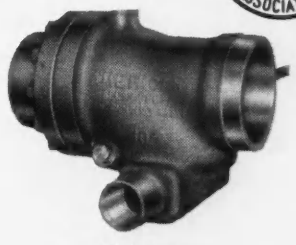

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section from 6448 to 6454 feet was retested and recovered 92 feet of distillate and 122 feet of distillate-cut mud. This same section was reperforated, tested, and recovered 117 feet of distillate and 45 feet of distillate-cut mud. Eight additional feet were perforated with six ½-inch shots per foot and a test of the section from 6448 to 6462 feet gave a flow of 0.6 barrel of distillate and 99,097 cubic feet of gas with 1 percent bs&w per hour. A production packer was set above the top perforation and the initial production was 19.2 barrels distillate and 2,641,171 cubic feet of gas with 4/10 percent bs&w. The cumulative production after a 2½-year period was 6998 barrels of distillate, 974,446 Mcf of gas, and 926 barrels of water.

The difficulty in obtaining penetration demonstrates the advisability of testing each set of perforations separately.

Centralizers and scratchers were placed on the bottom 280 feet of the oil string (Figure 16). Perforations were made from 6444 to 6446 feet with six ½-inch shots per foot, and the well tested 45 barrels of which 75 percent was salt water. One hundred twenty-eight sacks of cement was squeezed with a final pressure of 4100 psi. A drill-stem test was made on these perforations and recovered 45 barrels of oil per day with a 29 percent cut. The perforations were again squeezed with a total of 160 sacks of cement with 5000 psi maximum and final pressure. The test after this squeeze recovered the water cushion and ten feet of mud. Perforations were then made from 6443 to 6445 feet with 12 ½-inch shots. The well flowed at the rate of 57.6 barrels with 45 percent cut. Upon completion, the well came in flowing by heads. After setting a pumping unit, the initial production was 92 barrels of oil and 138 barrels of salt water. The total production for five days was 456 barrels of oil and 806 barrels of water.

The perforations should have been squeezed before testing to reduce the tendency of water coning. The thickness of the saturated section, as indicated by the electric log, was only four feet.

## Conclusions

Scratchers and centralizers apparently aid in getting good primary cement jobs. They are usualy placed from the bottom to approximately 300 to 500 feet above the highest prospective sand, except in the case of rotary scratchers which are placed 15 to 20 feet above the sand. If the proper technique is used, there should be no difference in the length of pipe equipped with the various types of scratchers. The use of such equipment eliminates to a certain extent the necessity of block squeezing before completing. However, it is general practice for some companies to squeeze even though the previously mentioned equipment is used.

The same perforations or perforated interval is used in many cases for both squeezing and completion. If the production squeeze does not block the perforations, they are used for completion without reperforating. It was thought that one reason the perforations were not plugged after a squeeze job was that shale and shaly sands behaved as a plastic and would flow under pressure. This would either force the mud filter cake into the overlying perforations through which cement was not flowing or plug the perforations with shale. Another reason is that if the cement sheet outside the pipe is relatively thin, the differential caused by releasing the squeeze pressure or the pressure differential due to production would be sufficient to break the cement into the well bore.

If two zones are perforated for completion, it is suggested that each zone be drill-stem tested before final completion.

It was thought that better squeeze jobs could be obtained if shaped-charge perforations were used, because of a more uniform pattern, greater penetration, and less chance of cracking the cement.

It was the opinion of the committee that the minimum distance for completion was four feet below the gas-oil contact and two feet above the oil-water contact. It was pointed out that by theoretical generalizations, other things being equal, it should be possible to successfully complete nearer a gas-oil contact than an oil-water contact. That the opposite is indicated by this study is partially due to (a) the conservative manner in which the oil-water contacts were selected coupled with the generally thinner gas-oil transition zones as compared with oil-water transition zones; and (b) that drawdowns in these saturated reservoirs cause gas to come out of solution and tend to develop relative permeability to gas.

Gravel packing was considered to be more successful than plastics; however, there were failures reported using both methods. It was suggested that the casing be milled out opposite the producing section and underreamed before gravel packing to give a greater productivity index and to reduce the velocity of flow through the outer edge of the pack.

In contrast to other areas, production in the Gulf Coast is obtainable even in these thin sections with drawdowns as low as 50 to 60 psi. Because of this, water and/or gas is successfully shut off with relatively small cement intervals.

One reason for the failure to obtain satisfactory completions by the above methods was placing the top of the sand at the first increase of the self-potential curve rather than at the point of inflection. The opening of this sandy shale section to perforations resulted in plugging the plastic or gravel pack.


### ACKNOWLEDGMENT

The author wishes to acknowledge the many suggestions and free exchange of ideas of the API Thin Oil Column Subcommittee. The author also wishes to especially thank Benjamin C. Craft, Louisiana State University; J. Howard Rambin, Jr., The Texas Company; Earl M. Kipp, The California Company; and Weldon W. Ramseur, Gulf Oil Corporation.


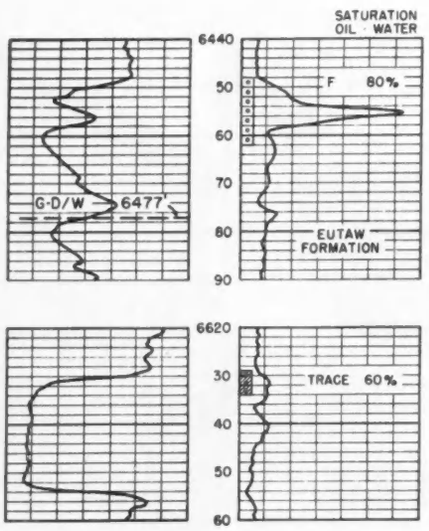


FIGURE 15. Inability to obtain penetration.

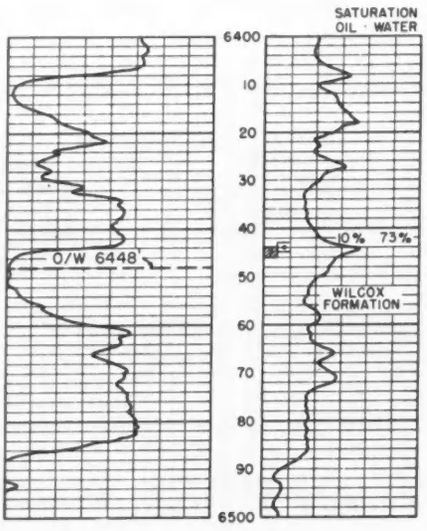


FIGURE 16. Failure to squeeze before completion.

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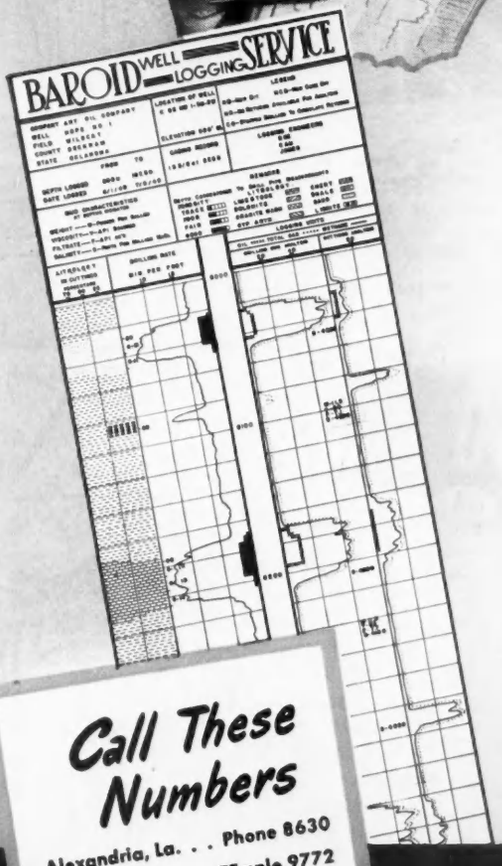


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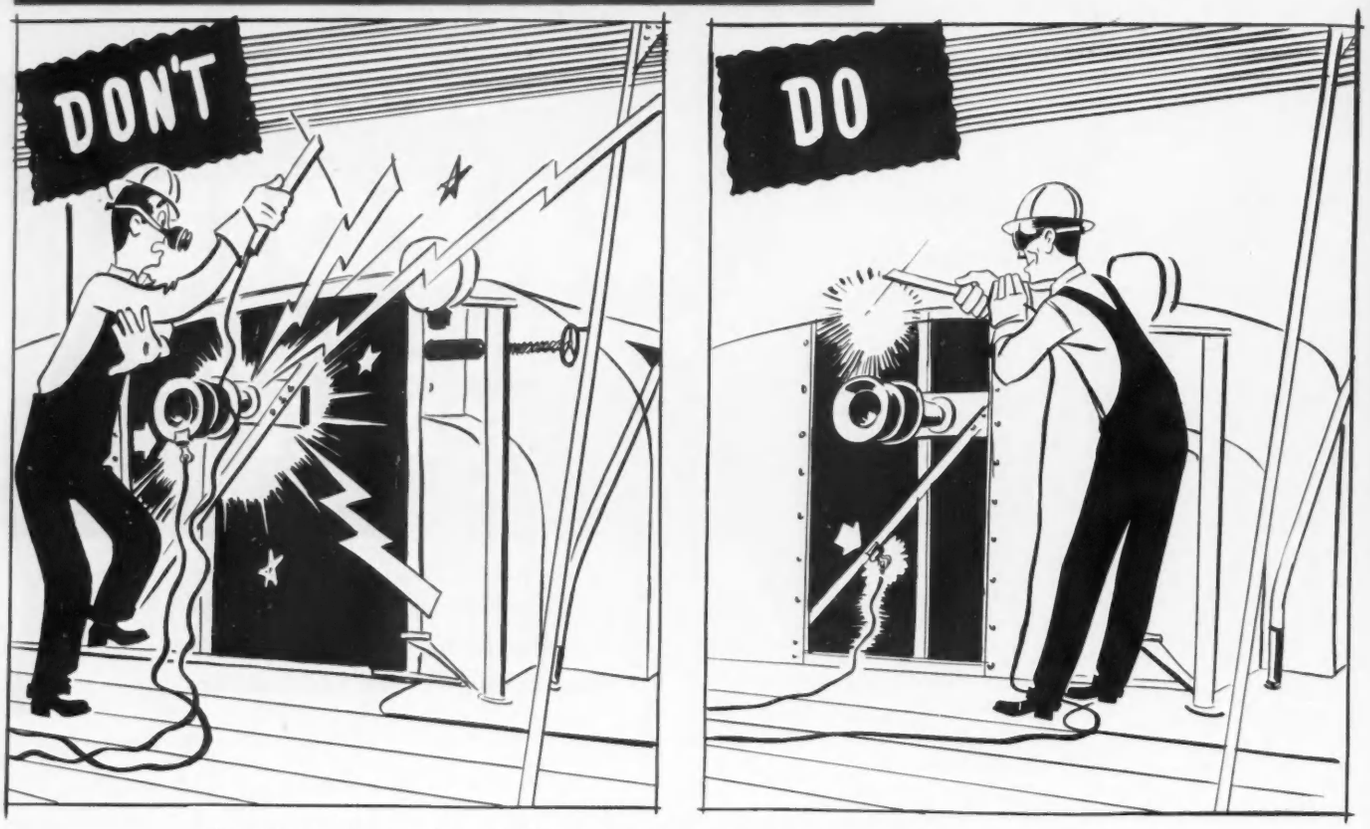
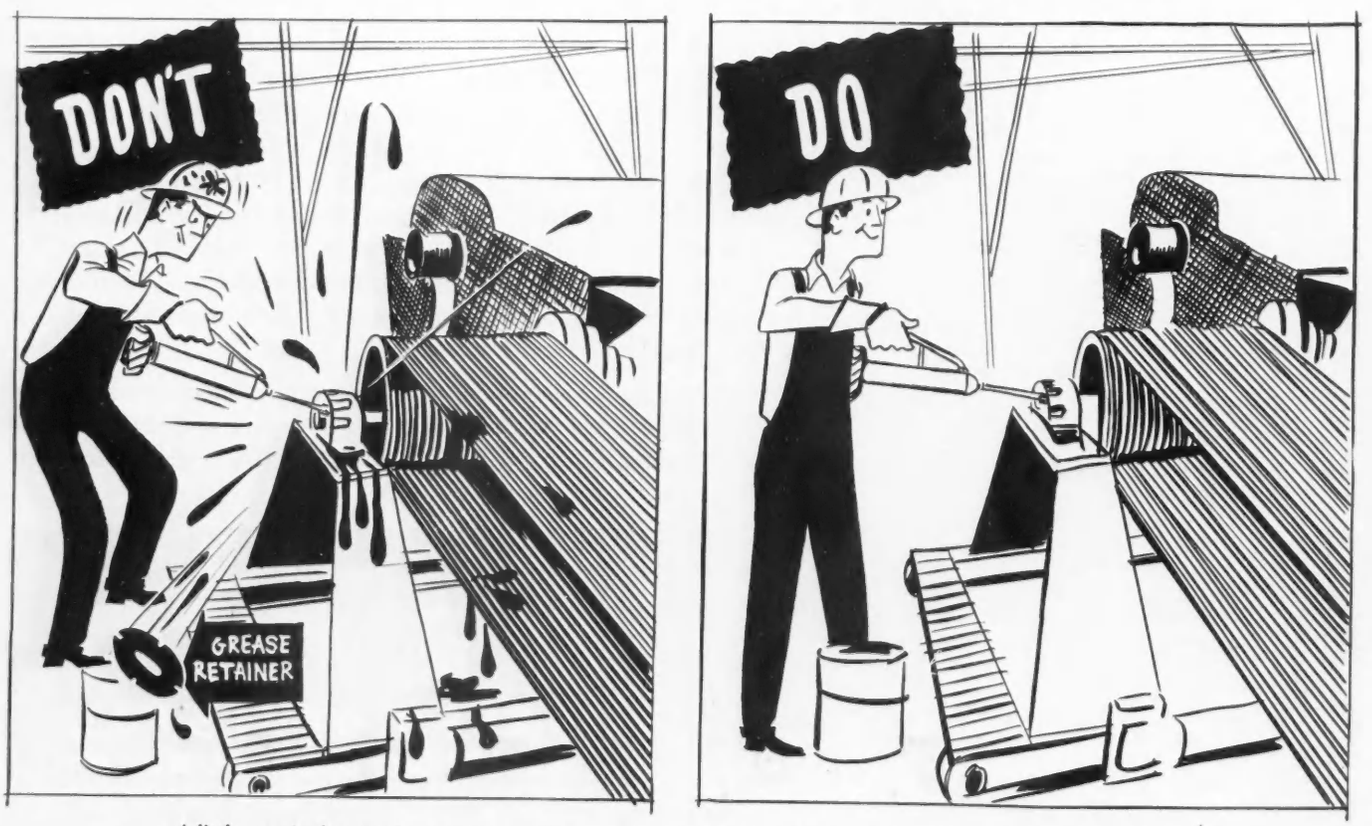
# World Oil Graphics

## BEARING CARE



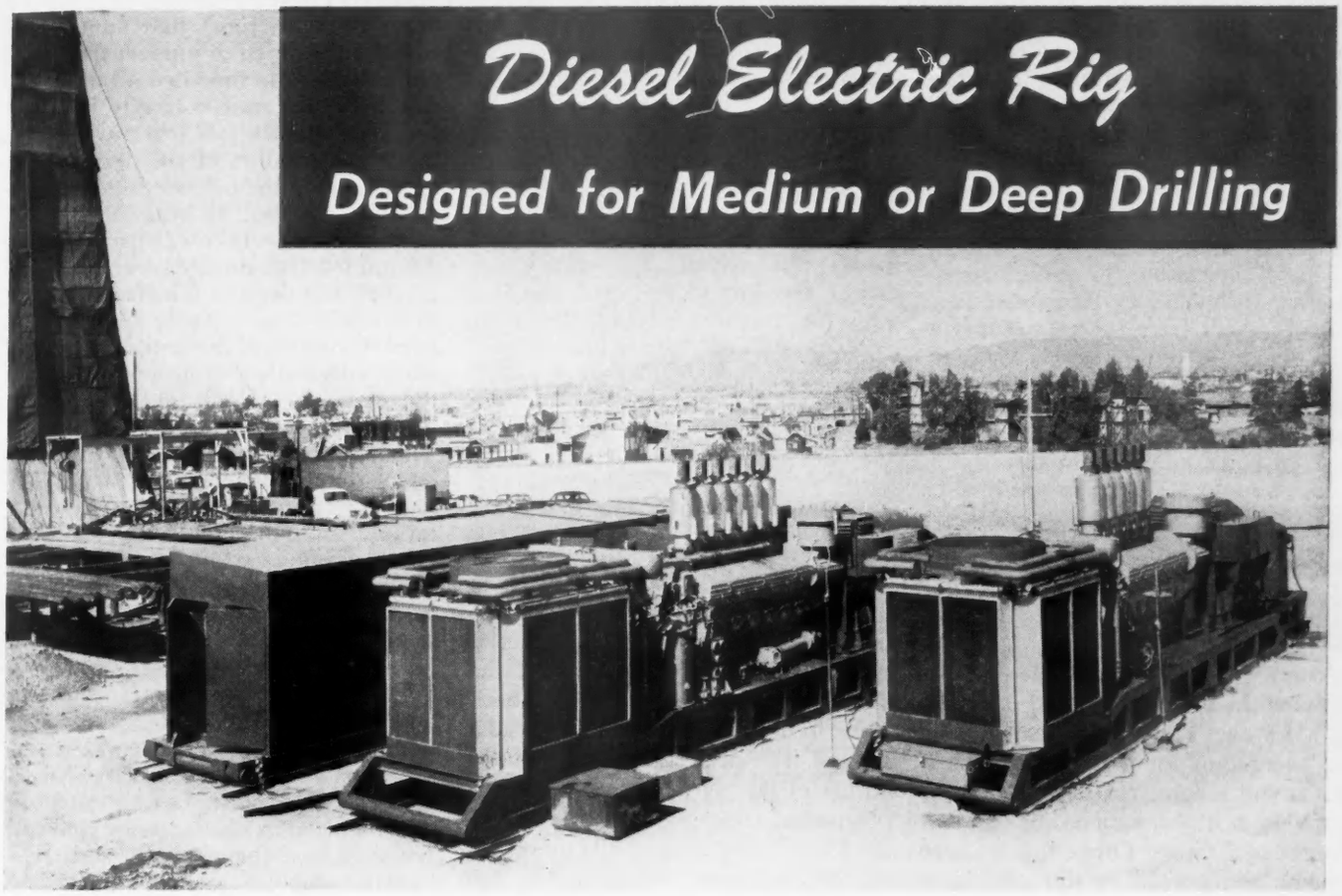

Arc-pitted bearings may be avoided by attaching the ground line to the unit part which requires welding.




A little care in the use of a grease gun will prevent damage to the retainer and insure increased bearing service.

# Diesel Electric Rig

## Designed for Medium or Deep Drilling



The 750 revolutions per minute locomotive type diesel engines in the photo are cooled by unique dual radiator units in which engine lubricating oil is cooled. A fan, mounted at the top of the dual radiator unit, is driven through a right-angle gear box from the front end of the engines. One radiator unit is employed for engine cooling; the other is used for water circulating to the lubricating oil cooler. For moves in the field, each of the two diesel engine generator sets is hauled as a single unit. For highway moves, the generator unit, mounted on a separate skid base, can be detached, pulled out of engine base slot and hauled separately. Although the electric motor driven rig operates quietly and with little vibration, derrick was sound-proofed because of its proximity to homes and adjacent movie studio sets.

By GILBERT M. WILSON
WORLD OIL Staff

A 2400-HORSEPOWER diesel electric drilling rig of somewhat unconventional design which incorporates numerous features that provide extreme flexibility in rigging up, tearing down and moving, has been completed and put in operation by Standard Oil Company of California on a deep test in the Inglewood field of Los Angeles County. Features of this rig, one of the largest diesel electric rigs ever built, include the portability of its "packaged" components, flexibility of installation at the well site and, of particular importance, the capacity to handle, with equal economy of operation, both the routine drilling of 8000- to 12,000-foot wells and the infrequent deep tests in excess of 20,000 feet.

The principal components of the rig are two diesel locomotive-type engines salvaged from Navy LST's, six generators and four direct current motors salvaged from other World War II marine equipment, and a drawworks taken from an idle steam rig. Exclusive of the derrick, substructure, drill pipe and other miscellaneous equipment, the rig represents an expenditure of nearly $400,000. It is estimated that, to duplicate the rig, using all new equipment, would add approximately 75 percent to the cost.

**HERE IS A UNIQUE diesel electric rig that is capable of drilling below 20,000 feet. The rig employs a power plant fabricated with war surplus equipment and a drawworks taken from an idle steam rig. Exacting generator response plus governed motor torque is provided by a simple amplistat system. Silent, high speed chains transmit power from the drawworks shaft without the development of damaging vibration and heat. Among other unconventional features of this rig, the drawworks is spotted on the ground to eliminate the need for a heavy substructure.**

Portability, one of the basic objectives that was sought in designing the rig, was achieved by assembling the equipment into compact packages that comply with highway regulations and which contribute considerably to the reduction of costs of rigging up and tearing down in the field. The electrical equipment and drives were designed to provide improved operating

characteristics, lower maintenance, and to assure maximum safety from fire or explosions. A fresh air circulating system delivers filtered air to all motors and certain electrical control equipment.

### Flexibility of Operation

An advantage of the rig is its flexibility of operation. Two 1200-horsepower, 12-cylinder, locomotive-type diesel engines drive direct current generators to provide electric power for drawworks, rotary table drive, mud pumps and other auxiliary uses. Each of the two generator sets actually consists of three independent direct current generators, two being mounted in line with the engine power take-off clutch and the third, V-belt driven from the end of the second generator shaft. One generator is a 1200-kilowatt, 525-volt unit used for driving the drawworks and mud pumps; the second is a 300-kw, 230-volt unit for driving the rotary table; and the third is a 150-kw, 125-volt constant potential generator for powering auxiliary units and amplidynes which, in turn, provide field excitation for the two larger generators. Other functions of the amplidynes will be discussed later in the article.

The direct current motors provide rapid, smooth acceleration of loads with absolute control of speed and torque. During normal operations, the rig is exceptionally quiet and free of vibration. For normal drilling operations, either of the two 1200-kw generators may be selected to drive a mud pump motor and either of the two 300-kw units may be used for the rotary table. The two 1200-kw units are paralleled for driving the 1500-horsepower, 525-volt, 600-rpm drawworks motor. In terms of high gear fast line pull, this provides 29,000 pounds for accelerating and, with 8 lines strung, approximately 10,000 feet of 4½-inch drill pipe can be started from bottom in high. For extremely deep drilling, ten lines are strung.

### Drawworks at Ground Level

The drawworks is mounted at ground level and the rotary machine and motor are on a substructure independent of the derrick floor. A special substructure, also independent of the derrick floor, allows drill pipe setback loads to be transferred directly to the ground. The driller's console is in one corner of the rig and permits an unobstructed view of the derrick floor, the latter being clear of all equipment except catworks, rotary table top (which is nearly flush with the floor) and the air-powered slips.

Setting the drawworks at ground level eliminates the necessity for a heavy substructure that normally would be required to support the unit. On a drawworks mounted on the derrick floor, the unit normally is positioned so that the fast line travels just inside the confines of the derrick. In order to keep the fast line in the same relative position, it was necessary, when the drawworks was mounted at ground level, to rotate the drawworks through 180 degrees. The front of the drawworks thus actually faces away from the center of the well. The drawworks, originally a steam-powered, but redesigned and rebuilt for this particular rig, is a two-shaft, two-speed unit. The high speed drive is equipped with an air-operated friction clutch and the low speed drive, because of space limitations, is equipped with an air-operated jaw-type clutch.

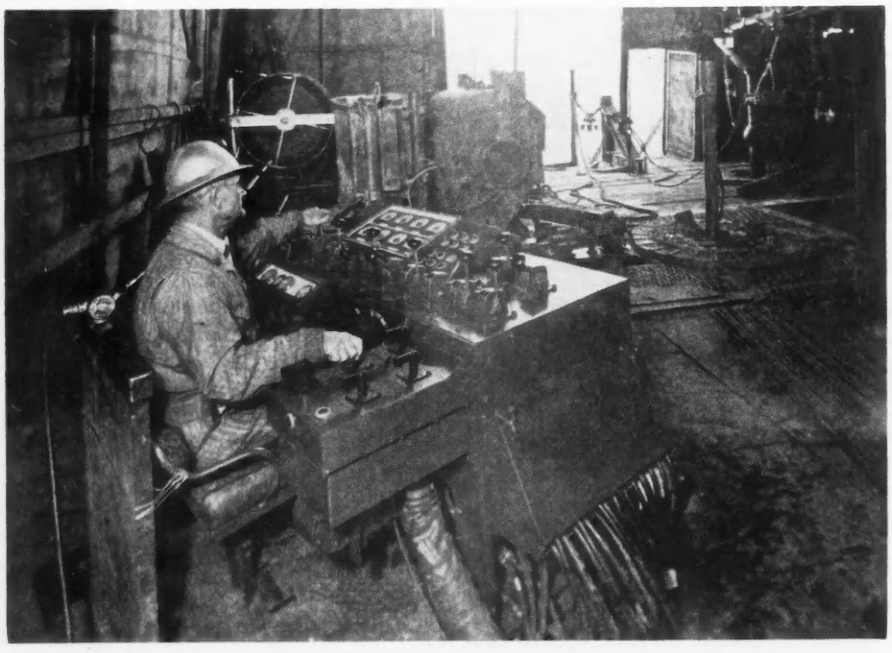
Silent chain is used on the drawworks shaft drives. This is a chain designed for high speed, heavy duty application. It provides an extremely quiet and efficient power transmission and has a very high load capacity per unit of width. It also greatly minimizes shock loading of chain links. It almost eliminates the noise, heating and vibration often associated with conventional oil field chain drives.

Although it is expected that the low speed drive seldom will be used, the low gear pull, with ten lines strung, is capable of handling a maximum hook load of 750,000 pounds. The drum, grooved for 1⅜-inch wire line, is 32 inches in diameter by 57⅝ inches long. The 62-inch brake rims are individually cooled by a forced water circulating system. The brakes are 100 percent air operated.

A unique air system is provided for operating the brakes from the driller's console on the derrick floor. Each brake is equipped with a double-acting air cylinder. The back side of the cylinder is supplied with ten-pound air pressure which holds the band in the released position. On application of air pressure to the other side of the cylinder—any pressure over ten pounds per square inch—the brakes are applied. This arrangement does away with the equalizer bar or spring mechanism that ordinarily is used to release the brakes.

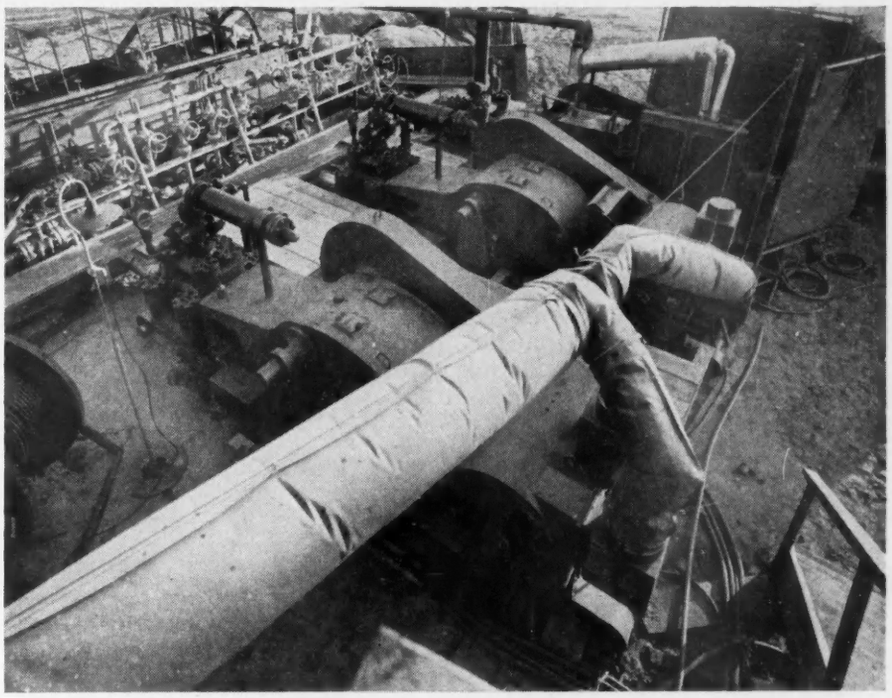
A spring-loaded emergency brake, which can be operated by the driller in the event of any emergency and which is automatically applied in case air pressure should fall below 80 pounds per square inch, also is provided. The drawworks also is equipped with a 60-inch dynamatic electric brake. The direct current motor driving the drawworks is all enclosed and is fresh-air ventilated.

The two 500-horsepower, 7½ x 16 mud pumps are driven by enclosed,



**Taken to illustrate driller's unobstructed view of rig floor area, this photograph shows the skid-mounted console, in foreground, catworks, floor-level rotary table and air slips which are the only principal items on the derrick floor. Heavy rig substructure is eliminated by placing drawworks at ground level and providing separate, independent substructures for drill pipe set back (at right) and rotary table and motor. Power for the drawworks is provided by a 1500-horsepower direct-current motor. Braking is supplied by a dynamatic unit. Drum is grooved for 1⅜-inch line. Catworks is mounted atop drawworks under floor. Drilling line, coming up through opening in floor, is visible beyond driller's left hand. Note fresh air ventilating duct connected into control unit of driller's console.**

fresh-air ventilated, 765-horsepower, 500-volt, 1120-revolutions per minute direct current motors. The motor and pump are mounted as a single skid-base unit. Either pump may be stopped at the driller's position, but for safety reasons, restarting and controlling of the speed may be done only at the mud pump master switch position. The pumps, like the drawworks, are equipped with silent chain drives. The use of direct current electric motor drives on the pumps is expected to considerably reduce pump maintenance. The amplidyne control of the direct current motor provides a drooping speed characteristic which is ideal for mud pump service. Presetting of the maximum torque of the mud pump motors will cause the pumps to slow down and stall in case of excessive pressure being developed by a clogged bit or other restriction of the circulating system. The system protects the fluid end from excessive pressures and prevents damage to the power end. A third pump, used primarily for mud-mixing, currently is diesel-engine driven but it is planned that this unit ultimately will be equipped with an electric motor drive similar to the other pumps.



**In this view, taken from derrick floor, can be seen how fresh, filtered air is delivered to the 765-horsepower, direct current mud pump motors. Through use of amplidyne control, the driller is able to preset maximum torque of pump motors. Such control also provides speed characteristics ideal for mud pump service. Third pump, used for mud mixing, will be equipped with electric motor drive. Mud flow line manifold assembly (upper left) is unitized for hauling as a single, skid-mounted unit.**

### Rotary Substructure

The rotary machine and motor are mounted under the derrick floor on a substructure independent of the derrick substructure. The rotary table is placed practically flush with the derrick floor, providing safe footing for the drilling crew. A universal joint type shaft drive is used between the motor and table, permitting the table to be shifted 2½ inches in any direction. The independent substructure supporting the rotary table eliminates the need for a heavy derrick substructure and at the same time facilitates the installation of the blowout preventer since the table can be lifted out and the preventer installed from the derrick floor level.

The driller's controls are placed in a compact, skid-mounted console set up in one corner of the derrick floor. Use of both pneumatic and electric controls permits fingertip operation of the entire rig. In addition to the conventional air controls for drawworks clutches, cathead, air slips and other equipment, electrical contactors are provided for selecting the various combinations of generator drives. The driller, for example, may start, stop, accelerate and switch rotary and drawworks' drives at will and may select either of the 300-kw generators for the rotary table drive. Full motor horsepower is available over a wide range of speeds, each of the various controllers having an infinite number of speeds, from zero to maximum, forward and reverse. This arrangement provides an extremely wide range of speed and insures instantaneous, accurately-controlled speed changes. This is particularly advantageous for the shaft-driven rotary table where speed and torque can be measured and adjusted for changing drilling conditions. The speed control switches at the driller's console are mounted in fresh-air pressurized units.

### Engines Use Low-Cost Fuel

The two 12-cylinder, 750-rpm diesel engines previously were used as the port and starboard main propulsion engines in a Navy LST. They originally were rated at 900 horsepower for continuous service. They were completely reconditioned and provided with suitable cooling for the increased horsepower to be used on the rig and now are rated at 1200 horsepower for intermittent duty. A unique cooling system was developed for the oil field application of the engines. A fan, installed in a horizontal position, is mounted at the top of the dual radiator unit and is driven through a right angle gear box from the front of the engine. One radiator unit is employed for engine cooling, while the other is used for water circulating to the lubricating oil cooler.

A low-cost industrial type diesel fuel is being used in the engines, replacing the more expensive fuel generally used for oil field service and it should effect some substantial savings in fuel costs. Fuel is gravity fed from a nearby storage tank and is maintained at a constant level in the day tank by means of a float-type valve in the inlet line. In order to maintain constant fuel temperature, fuel is circulated continuously between the day tank and the engine.

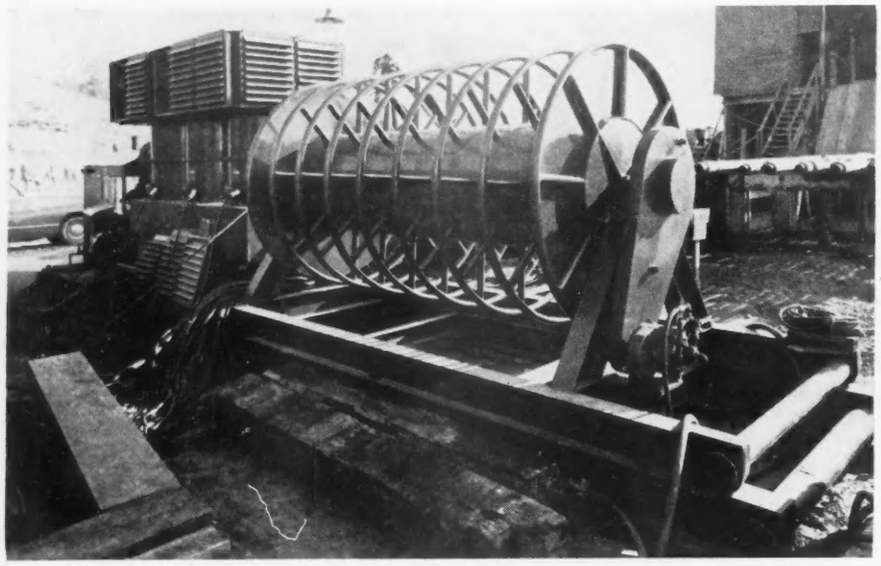
### Unitized Main Control Panel

In a separate, enclosed, skid-mounted control panel is housed the main electrical control equipment. This equipment consists primarily of necessary control and transfer switches, necessary control and transfer switches, contactors, relays, amplidynes, alternator and other electrical devices. The arrangement of the distribution system, as can be seen in the electrical distribution diagram, permits maximum operating versatility. The main generator units may be par-

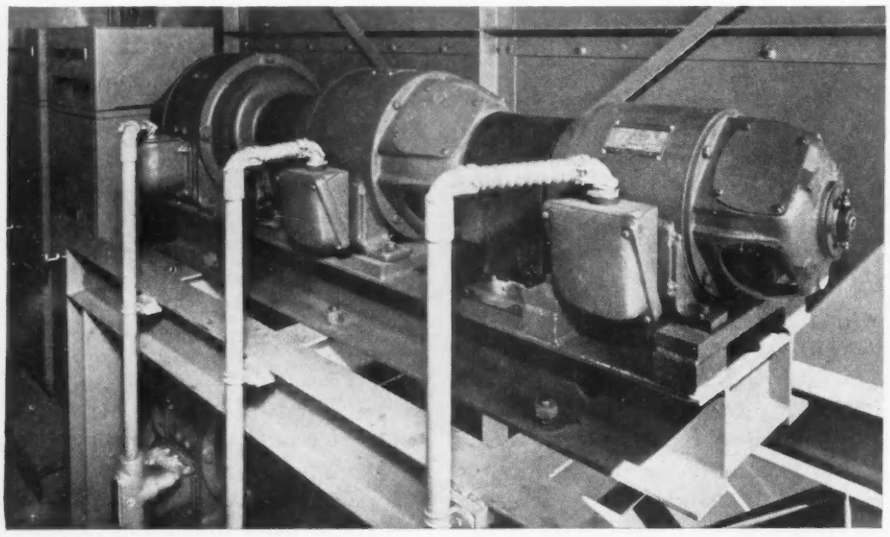
alleled and the power distributed in any desired combination between the two mud pumps and the drawworks motor. Two motor units are provided for excitation of the main 1200-kw generators (five-kw amplidyne for each main generator) and the 300-kw rotary table generators (two-kw amplidynes). The two amplidynes are connected by a flexible coupling and are driven by a 15-horsepower electric motor. The use of amplidyne current limit exciter control gives instantaneous response to the driller's control and assures equal distribution of load between the two main generators when they are paralleled.

The amplidyne is a direct current machine similar, in many respects, to a direct current exciter. It has characteristics such that a very small direct current signal will give a high speed amplified response that will very accurately control the output of main generators. The amplidyne is used in conjunction with a magnetic amplifier, the amplistat, which has no moving parts and provides extremely accurate amplification of a very small direct current signal.

The amplistat picks up the voltage drop across the commutating field of the generator and amplifies it to a point where it controls the amplidyne. The amplidyne, in turn, controls the output of the main generators driving the mud pump, rotary table and drawworks. This control system permits the characteristics of the driving motor to match the characteristics of the driven equipment. It allows the driller to control accurately the output of the largest motors by turning a small potentiometer dial that is no larger than a radio dial. In addition, the use of amplidyne control provides a means of limiting the torque on the motors as they can be preset to limit the power that the generator can deliver to them. All motors are equipped with builtin electric heaters which prevent accumulation of moisture in motor windings when the rig is shut down under high humidity conditions. More than 3500 feet, an amount weighing approximately seven tons, of 1000 MCM cable (approximately two inches in diameter) is used for power connections between generators, motors and control points. To supply power to rig auxiliaries, such as blower motors, shale shaker, brake water circulating, lighting and rig heating, a 3-phase, 60-cycle, 440-volt, 100 kva alternator is provided.



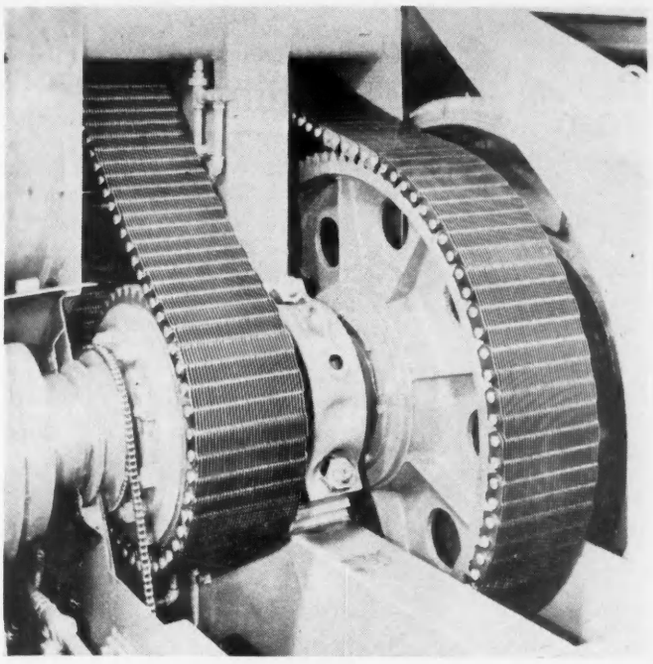
**Power cables are reeled and transported on this large power-operated reel. Winding of the heavy power cables—of which there are more than seven tons—is facilitated by the air motor drive visible at the end of the reel. The three axial flow blowers, at extreme left, deliver filtered air to all rig motors, main control panel and the driller's console.**

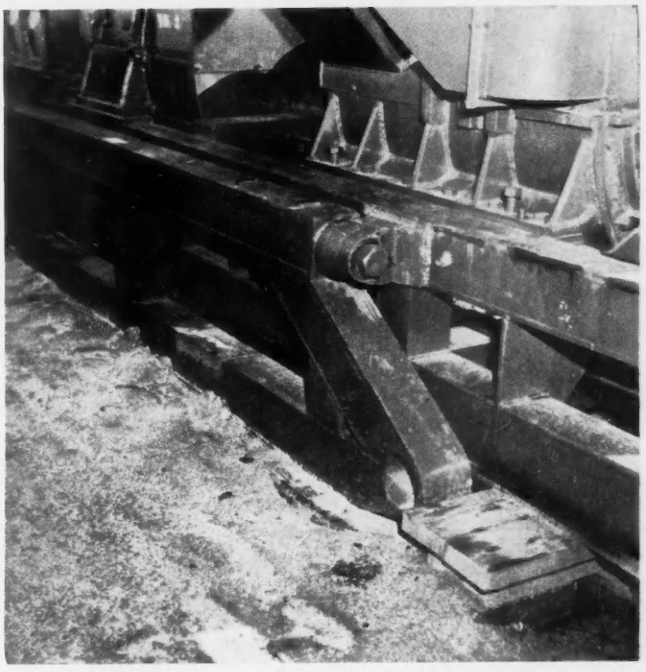


**Important to the efficiency and ease of control are these amplidyne motor units housed in separate, enclosed sections of the control panel unit. They are used for excitation of main generator and rotary table generators. Amplidyne voltage control enables the driller to control accurately the output of the large motors and makes it possible for him to preset or limit power that can be delivered to the motor. This important feature, it is hoped, will minimize twistoffs and materially improve operating efficiency. A feature of the master control unit is pressurized, fresh air intended to eliminate the accumulation of dust in electrical compartments. Main control panels are furnished with electrical interlocks which automatically de-energize the panel when doors are opened.**

### Filtered Air Delivered to Motors

A constant supply of fresh, filtered air passes through all electrical units where there is a possibility of explosive gases accumulating. Three axial flow blowers, mounted as a unit on a skid base which also carries the cable reel, are located approximately 90 feet from the derrick. Intake of the blowers is seven to eight feet above ground level. The filtered air passes through a large canvas duct located under the pipe walkway and at the derrick substructure, is taken off through feeder ducts to the drawworks motor, rotary table motor, mud pump motors and the driller's console. The air keeps the motors at safe operating temperatures and prevents accumulation of explosive gases inside the housings. The main control panel also is ventilated by means of this forced draft system in order to prevent collection of dust on electrical relays and other devices. In order to make sure that motors and console are purged of any gas which might have accumulated during a shutdown, secondary power circuits are electrically interlocked through a time-delay relay so that the blowers





**LEFT: Close-up view of silent type chain as used on the drawworks shaft drives. Used also on the pump drives, this type of chain is designed for heavy duty, high speed operation and provides extremely quiet and efficient power transmission.**

**RIGHT: This is one of the alignment cones, of which there are four on each engine-generator set, which assure fast, accurate alignment of the two units when they are reconnected in the field. Other cone, on this side of the unit, is located at front end of slot below level of base top. Engine-generator sets are designed to be set up on wood mats to eliminate costly foundations.**

must be started before motors can be started. The generators are cooled by a fan located on the main generator unit, the air being sucked through a filter box and discharged through the generators.

To assure protection of personnel and equipment, a number of safety devices are provided. Excessive current in any motor will light an alarm signal at the driller's console. A relay is provided to prevent engine overspeed due to electrical power pump-back in the event the drawworks motor inadvertently would be connected when running pipe in the hole. This safety device is operated by a tachometer mounted on the engine and operates a solenoid valve on the drawworks air brake. In the event of overspeed of the drawworks motor, a tachometer on the motor operates an alarm signal. A control at the driller's position which kills all electric energy beyond the load side of the main panel can be operated in the event of any emergency. Main control panel doors are equipped with electrical interlocks which automatically de-energize the panel when doors are opened.

### Portability Prime Objective

One of the original and basic objectives in the design of this drilling rig was to make it highly portable so that it can be moved, set up and used with equal efficiency for drilling to most depths. An important consideration in the use of diesel electric power is that the power generating and control units may be set up in the most advantageous locations at the well site, a feature particularly desirable when operating in hilly terrain. All units are self-contained and it is unnecessary to dismantle any chain drives when changing locations.

For over-the-road travel, the unitized skid-base mounted pieces break down into 12 packages, and for moves in the field where highway road limit restrictions would not apply, they can be moved in eight packages. When moving in the field, the engine-generator set, weighing approximately 96,000 pounds, is moved as a single unit. However, when the unit is moved over the highways, the set breaks down into two separate packages, each of which meets California road width, height and weight requirements. The slot mounting arrangement by means of which the engine-generator units are connected, is shown in detail in an accompanying photograph. Permanent alignment is assured between the two units by the use of four alignment cones. The engine-generator units are designed to be set up on wood mats, thus eliminating the need for expensive concrete bases.

The dynamatic brake and drawworks motor are removed from the drawworks package when it is necessary to keep this unit within highway limitations. Making up the 12 packages to which the main rig elements can be reduced for highway moves are: a skid-mounted unit for each of the two diesel engines; one for each of the two generator units; one for the electrical control panel; one for the drawworks; one for the drawworks motor and dynamatic brake; one for the catworks (to which the blocks are added to make a load); one for the rotary machine unit and motor; one for the ventilating blowers and power cable reel unit; and one for each of the two slush pump units.

### Eight-Section Reel

The large reel on which power cables are reeled and transported is divided into eight sections and is driven by an air motor mounted at one end of the unit. All cables are numbered and coded to facilitate correct coupling in the field and are equipped with indexing pins that prevent incorrect installation of terminals.

That the new rig is performing satisfactorily and in accordance with original expectations is to be seen in the performance thus far turned in. The rig was spudded in its first well February 26, and not quite seven weeks later was drilling below 9000 feet, a period which included setting of surface pipe, spot coring, and running of electric logs.

# Getting Most from D.C. Drilling Motors

By LOUIS J. MURPHY

Consulting Electrical Engineer

New York City

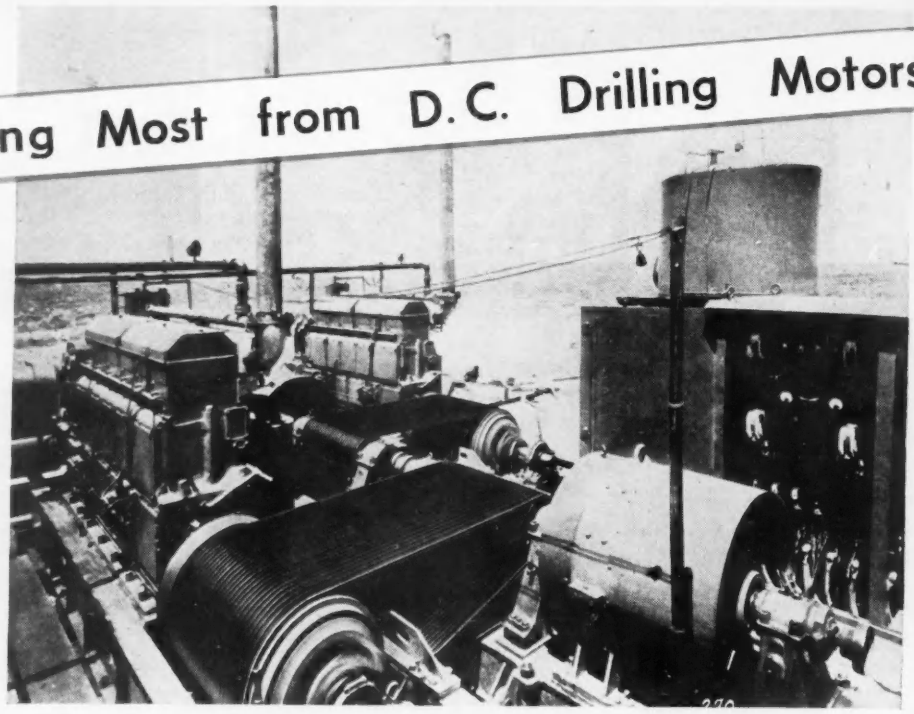


FIGURE 1. Drilling rig generating set supplies current to motors used in the rig. Outdoor installations such as this are subject to many weather and dust hazards. Careful maintenance is necessary for dependable operation.

**IN A RECENT article the author discussed the operation and maintenance of A. C. motors on drilling rigs.[1] He demonstrated that maintenance is essential for economical, trouble-free drilling. In this article he discusses operation and maintenance of D. C. motors and generators for drilling rig use.**

DIRECT-CURRENT generators driven by gas, gasoline or diesel engines (Figure 1) are the most common sources of power for drilling rigs. Voltage used may be 110, 220, or 550 according to power needs and motors used. Switchboards for controlling generator operation are mounted close to the units. Direct or belt drive can be used, according to whether a speed change between engine and generator is necessary. Since distance between generators, switchboards, and motors is small, voltage drop between these units is negligible.

Direct-current units can be used both in normal drilling and in offshore operations (Figure 2). Ease of speed adjustment, freedom from expensive and intricate control devices and simplicity of maintenance make these units suitable for most types of drilling.

### Motors Used

For constant-speed applications in drilling rigs, either shunt or compound-wound motors are chosen. Series-wound motors are used for variable speed work. Shunt motors are best suited for loads with a starting torque equal to or less than the full load torque. A shunt motor maintains nearly constant speed as load increases, there being only a slight decrease in speed with rise in load. Highest speed occurs at no load.

Compound-wound motors have the combined characteristics of shunt and series motors. Speed is not excessive at light or no-load conditions and the motor has moderately high starting torque. It has, however, a larger variation in speed with changing load than the shunt motor. Compound motors are best for loads with high starting friction and inertia.

Series motors have very high starting torques and good efficiency at high speed. Because they race and may "run away" at light loads, series motors must not be used unless they are positively connected to the load or protected from racing. Highest torque for a series motor is at low speed.

All direct-current motors, regardless of type, must be adequately protected from dust, oil, and other injurious materials found around drilling rigs. Class 1, Group D enclosures are usually specified for this work.

### Motor Troubles

Direct-current motor and generator troubles are most easily found by classifying them under the following headings:

A. Commutator sparking.
B. Commutator and brush heating.
C. Armature heating.
D. Field magnet heating.
E. Bearing heating.
F. Noisy operation.
G. Incorrect speed.
H. Motor stops or won't start.
I. Generator doesn't produce current.

These troubles are the most common indications of one or more faults in the generator or motor. By starting with any one of these troubles and correcting them as shown below, it is usually easy to secure good, dependable operation.

**Commutator Sparking:** Excessive sparking will burn and cut commutator surfaces and the ends of brushes. Whenever a commutator sparks, heat is released, accompanied by a rise in temperature of the commutating bars. When sparking is excessive, heat in the commutator may flow to the bearings causing trouble there.

Sparking may be caused by any one or more of the following: (a) overload, (b) brushes at wrong angle, (c) rough commutator, (d) uneven brushes, (e) short-circuited armature coil, (f) open circuit in armature, (g) armature grounded, (h) field weak, (i) excessive vibration, (j) brushes jump.

Remedies are, respectively: (a) Decrease load, diameter of driving pulley or increase driven pulley size. (b) Set brushes at neutral point on commutator. The neutral point is found by shifting the brushes at no load and normal voltage until only a small spark appears at the edge of the brush. When set in this way, brushes will generally be satisfactory for both

full and partial load operation. (c) Rough commutators should be ground smooth with sandpaper, carborundum paper, or sandstone. Emery cloth may injure commutator surfaces and should be avoided. Where the commutator is badly worn or out-of-round, it should be turned true on a lathe. Diamond-point tools are used for cutting the commutator. (d) With commutator smooth, brushes should fit evenly with a large area of contact. Carbon brushes can be evenly fitted by rotating a piece of sandpaper underneath the commutator end of the brush.

(e) Rewinding of the armature is necessary where a coil is shorted. When a piece of metal or solder shorts commutator bars or leads, the fault is easily corrected by removing the metal. (f) Most open circuits occur in the connections between commutator and armature. Reconnect wire to proper bar, if possible. If not, connect to the next bar. When open circuit is in the armature, complete rewinding is usually necessary to correct the trouble. (g) Cause of the ground should be removed after it has been located either by a magneto and bell or the drop-of-voltage method. (h) Weak fields can be caused by one coil being reversed, a short-circuit, ground, or open circuit. Locate by methods given above. (i) Balance armature or pulley, reinforce motor foundation or tighten motor foundation bolts. (j) Brushes jump when commutator is uneven. Smooth both commutator and brush surfaces.

**Overheating:** This includes all types of overheating—B, C, D, and E. As long as a motor or generator is not too hot to touch, it is operating satisfactorily. Once the temperature becomes so high that the hand cannot be kept on it, there is a likelihood of trouble.

Brush heating can result from sparking, poor connections, shorts in commutator, or improper carbon in brushes. Sparking and commutator shorts are remedied as detailed above. Poor connections are plainly visible and should be repaired or replaced. The conductivity of carbon varies and unless the proper type is used, heating will result. Hence, when heating occurs, check the brushes to see that they have the proper conductivity.

Armature heating results from excessive current in armature coils, shorted armature coils, damp coils, reversed coils on one side of armature, and heat from other parts of generator or motor. Excessive armature currents are caused by overloading. Shorted armature coils, reversed coils, and heat from other parts are handled as discussed above. Damp coils can be dried out in an oven or by connecting the unit to run as a generator or motor at lowered voltage. Dampness in coils is detected by an insulation-resistance test.

**FIGURE 2. For driving centrifugal pumps in barge drilling setups, the D.C. motor, either direct-connected or with V-belt drive, serves the pumps for transferring water ballast, and for bulk transfer of other liquids.**

Field coils heat when current flow through them is excessive or when there is moisture in the coils. Moisture is removed by drying and current flow reduced by decreasing field coil voltage, increasing field circuit resistance, or shunting part of the current around coil, according to type of motor.

Bearings overheat when there is insufficient oil or lubricant, grit or dirt in the bearings, shaft is rough or scored, bearing is fitted too tightly, shaft is bowed or bent, bearing is out of alignment, too great a load on belts, or armature is off center. These troubles can usually be found by visual inspection and are corrected by removing the cause.

**Noisy Operation:** Belts flapping, armature rubbing poles, loose parts, armature vibration, loose bearings, rough commutator, belt slippage, and humming of armature teeth may all cause noisy operation. Belt flapping generally is a result of poor joints, causing the belt to slap the pulley every revolution. Joint should be repaired or an endless belt used. When armature rubs the poles, bearings must be readjusted so that air gap is correct. Either shims or new bearings can be used. Armatures vibrate when improperly balanced. Either the pulley or armature may be out of balance, causing the whole unit to vibrate. Balance by drilling out heavy side or by adding weights to light side. Loose bearings, rough commutator and belt slippage are easily corrected after detection.

Humming of armature teeth can be reduced by increasing the air gap, reducing distance between teeth, sanding the ends of poles, or reducing field strength.

**Incorrect Speed:** Low speeds are caused by overloads, shorted armature, tight bearings, or armature hitting poles. Excessive speeds result from too light loads. The remedy in each of these cases is apparent and easily applied.

**Motor Stops or Won't Start:** Excessive overloading, blocked armature (either by bearings, shaft, or poles), open circuit, or shorted circuits will prevent starting or cause motor to stop. To start motor, load should be reduced or the cause of blockage removed. Open and shorted circuits are handled as previously detailed.

**Generator Doesn't Produce Current:** Reversed connections, incorrect direction of rotation, short and open circuits, opposed field coils, and improperly adjusted brushes will reduce or stop current generation. Where field coils are opposed, reverse the connections. Handle the other troubles as shown above.

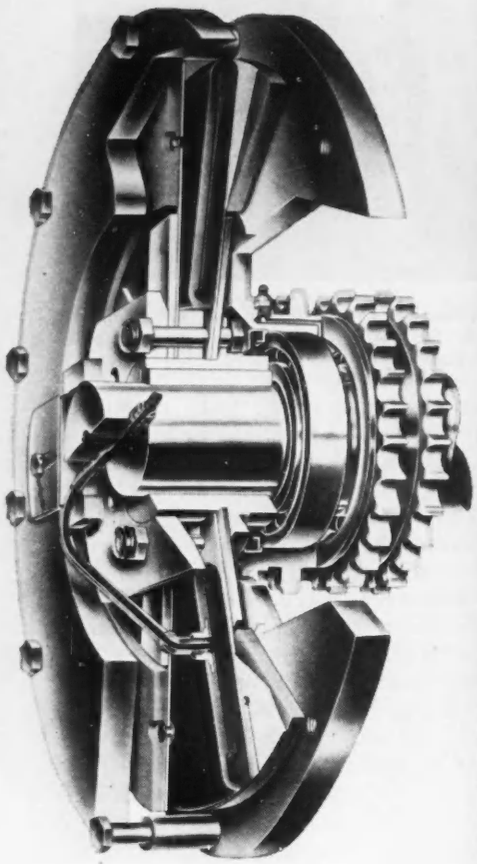
## Conclusion

Good maintenance, faithfully done, is the only way of assuring dependable operation of electrically-driven oil well rigs. The methods outlined here should serve as a good starting point for further study by drillers and maintenance men. Better output at lower costs is certain to result.

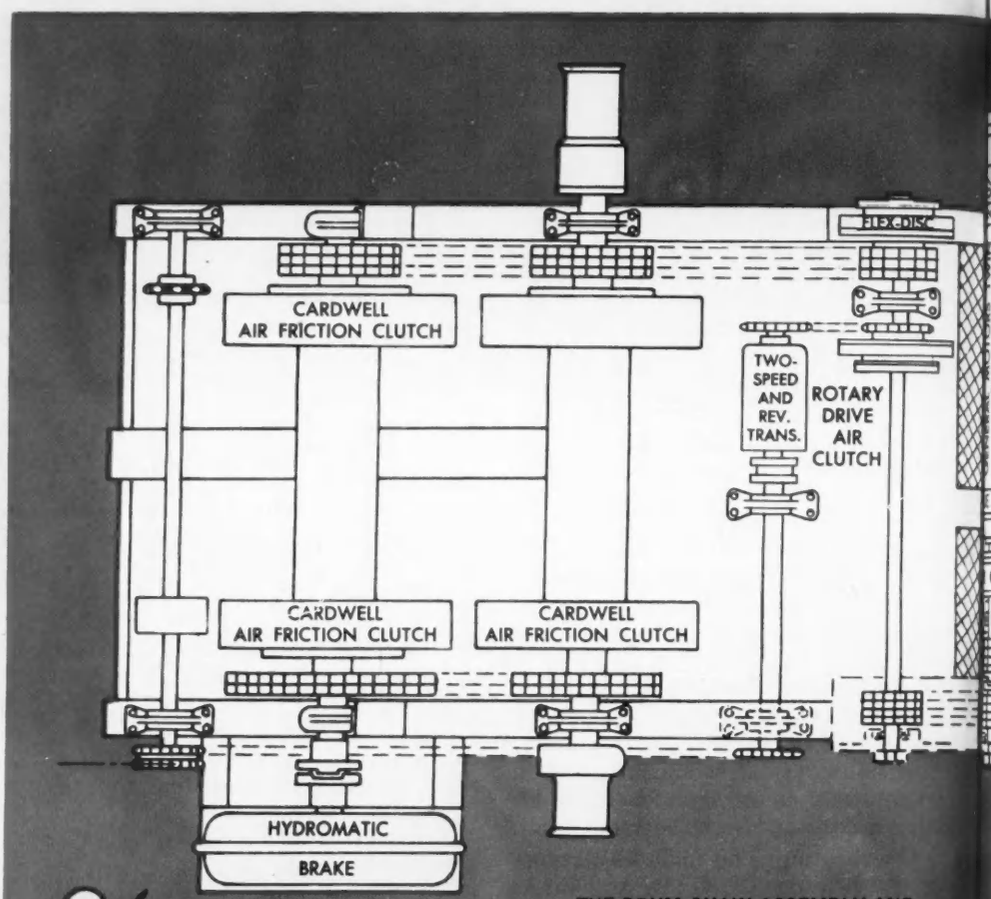
### REFERENCE

Murphy, Louis J., "Operating Guide for A.C. Drilling Rig Motors," WORLD OIL, Vol. 134, No. 4, p. 89 (March) 1951.

# 'MODEL O' THREE-
## with torque converters

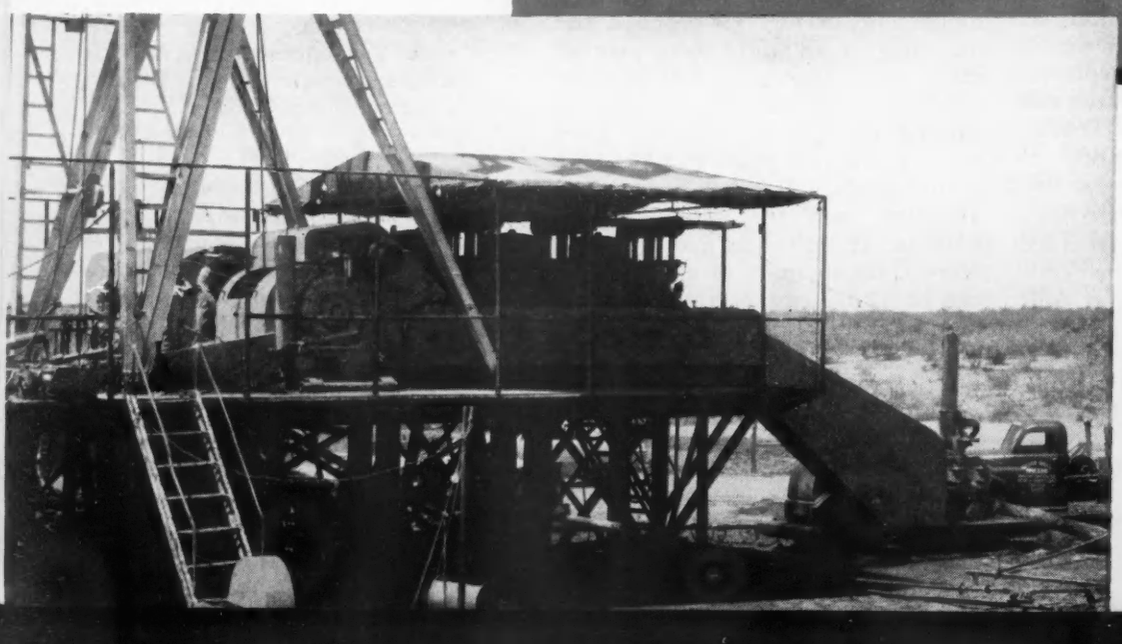


Model 38 clutch is already famous for NO FAILURE, NO ADJUSTMENT AND LONG LIFE WITHOUT REPAIRS. These Cardwell "Flex Disc" clutches are used to drive the drums, rotary table and pump.




FAST, SHOCKLESS DRUM ENGAGEMENT IS DUE TO CARDWELL "AIR DISC" FRICTION DRUM CLUTCHES.

THE DRUM CHAIN ASSEMBLY AND CATHEAD SHAFT MAY BE IDLE WHILE THE ROTARY TABLE IS OPERATING.



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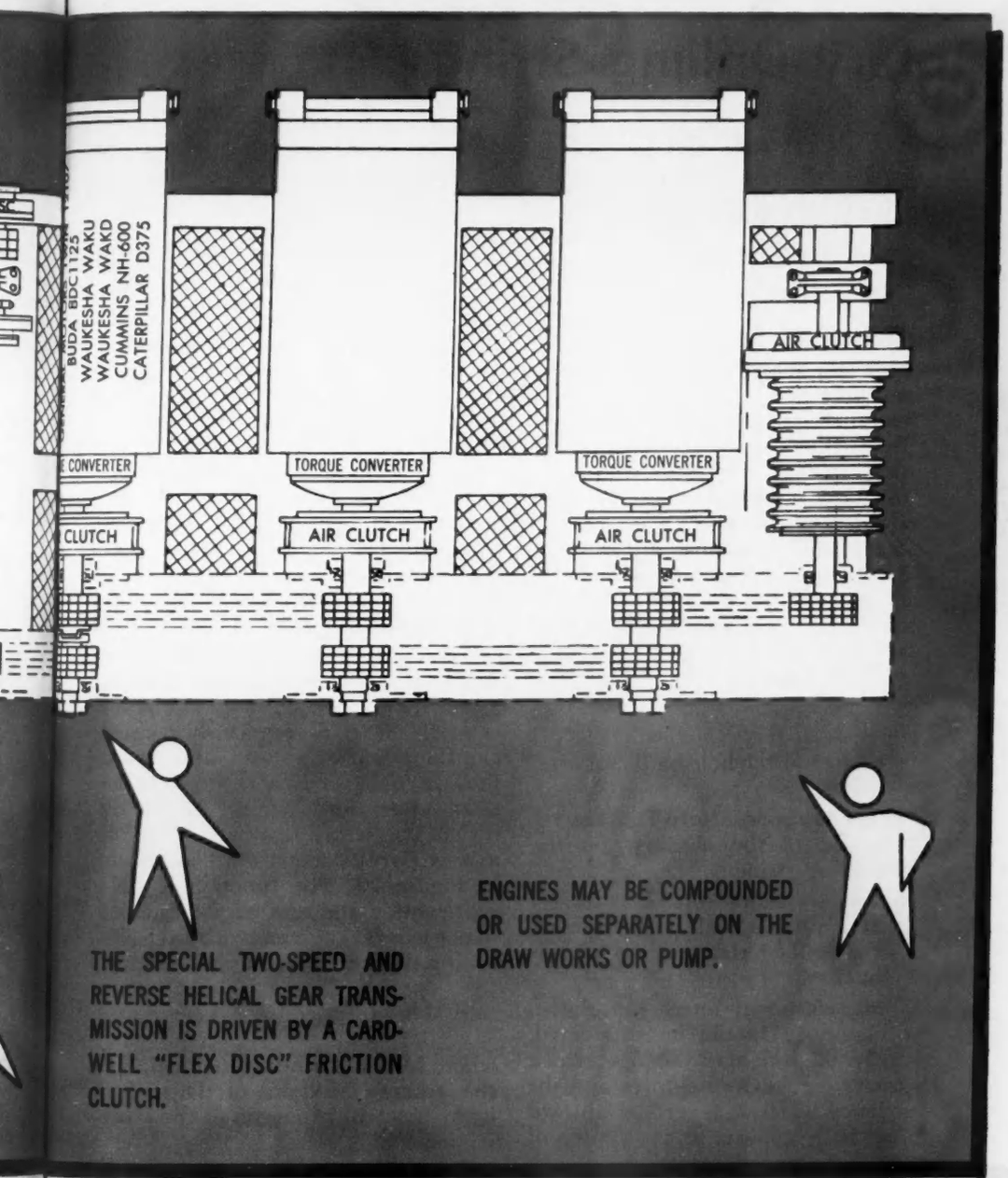
## s and Cardwell air clutches




THE SPECIAL TWO-SPEED AND REVERSE HELICAL GEAR TRANSMISSION IS DRIVEN BY A CARDWELL "FLEX DISC" FRICTION CLUTCH.

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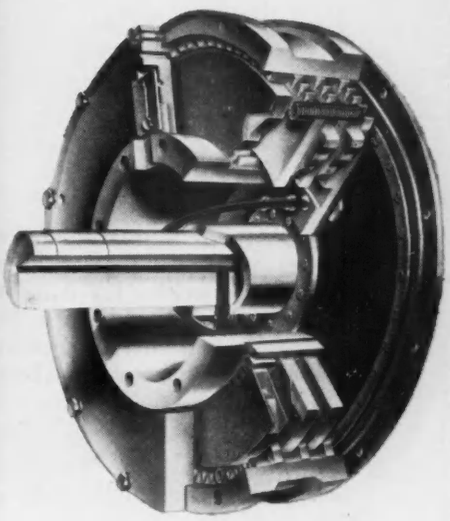

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# BUCKLING

# Of Rotary Drilling Strings

## Part 3

By ARTHUR LUBINSKI
Stanolind Oil & Gas Company

**THE AUTHOR formulates the problem analytically, assuming a continuous pipe and certain external forces acting thereon. By further analysis, he shows that critical functions are dimensionless and independent of types of drilling string and drilling fluid. Solutions of formulas indicate points where buckling of first and second orders occur and where bit weight changes are necessary to prevent string or hole damage.**

## APPENDIX

IN VARIOUS treatises on elasticity, applied mathematics or Bessel functions, 1, 2, 3 and 4 the only case of buckling with distributed weight which is analyzed, concerns a vertical pole with its lower end built in, and the upper end free. There is a reaction on one end only and this reaction is vertical.

The case of the drilling string is much more complicated. Both ends can be considered as hinged ends and, consequently, there are reactions on the string at both ends. These reactions have vertical and horizontal components. Moreover, there are reactions of the wall of the hole at the points where the buckled pipe contacts the wall.

### Analytical Formulation of the Problem

Start with an assumption that the drilling string is a continous pipe with no drill collars and no tool joints. The generalization of the results to combination strings comprising drill pipe and drill collars will be easy by the use of dimensionless units. The external forces acting on the drilling string are represented in Figure 19, in which:

1. The upward force $W_1$ is the reaction of the elevators on the drilling string.
2. The upward force $W_2$ is the vertical component of the reaction of the bottom of the hole on the drilling string and is commonly called "weight on bit."
3. The force $F_2$ is the horizontal component of the reaction of the bottom of the hole on the drilling string.
4. The horizontal force $F_1$ is the reaction of the bushings on the drilling string.
5. The horizontal force F is the reaction of the wall of the hole on the drilling string if the pipe is buckled.

Two additional forces not shown on Figure 19 should be considered, namely, the weight of the pipe, which is a vertical downward force and the buoyancy which is a vertical upward force, both applied to the center of gravity of the drilling string.

The influence of the viscous forces on the drilling string and of the "jet" force on the bit are neglected. They are small in comparison to the weight.

For $W_2 = 0$, i.e. when there is no weight on bit, the drilling string is straight and this straight form of elastic equilibrium is stable, i.e. if a lateral force is applied and a small deflection produced, this deflection disappears when the lateral force is removed and the pipe becomes straight again. If $W_2$ is increased, but maintained below a certain critical value, the straight form remains stable. If the critical value of $W_2$ is reached, the straight form of the pipe becomes unstable, i.e. if a lateral force, however small it may be, is applied and a small deflection produced, this deflection does not disappear when the lateral force is removed. On the contrary, the deflection increases until a bent form of stable equilibrium known as buckling is reached.

Choose as axis of coordinates X and Y as shown in Figure 20. The X axis is the axis of the hole. The point of origin N is the previously defined neutral point. It is well understood that the plane of X and Y axis is the plane of smallest flexural rigidity in which the buckling occurs. The X axis is directed downward as shown in Figure 20. The function Y (X) representing the axis of the buckled string can be represented by the following differential equation:

$$M = EI \frac{d^2Y}{dX^2} \quad \ldots\ldots\ldots\ldots\ldots (14)$$

where M is the bending moment, E is the Young's Modulus of the steel, I is the moment of inertia of the cross-section.

By taking the derivative both members of the equation (14), we obtain:

$$A = EI \frac{d^3Y}{dX^3} \quad \ldots\ldots\ldots\ldots\ldots (15)$$

where A designates the shearing force.

We shall determine now the shearing force along any cross-section of the drilling string such as MN (See Figure 19) and substitute the value obtained in equation (15). For this purpose, we shall determine all the known forces applied to the portion of the drilling string located below the

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section MN. These forces are represented vectorially on Figure 21, and they are: $W_2$ and $F_2$ already defined, W or weight of the portion of the drilling string located under MN, and the buoyancy. When saying "buoyancy" we assume that the drilling string is subjected to a hydrostatic distribution of pressure. Actually, the case is more complicated but, as shown later, the dynamic and static distributions of pressure lead to the same buckling characteristics. If the portion of the drilling string under MN is surrounded by the fluid, i.e. if we consider the portion above MN as non-existant, the buoyancy would be equal to the weight of the displaced fluid. $B_1$ represents this upward force on Figure 21. Actually, the hydrostatic pressure does not act on the section MN. This part of the buoyancy ($B_2$ on Figure 21) must be vectorially subtracted from $B_1$ to obtain the true buoyancy.

Since this portion of the drilling string which we are considering is in equilibrium, the vectorial sum of all the forces is equal to zero. As shown on Figure 22,

AB is the weight on bit or $W_2$

BC is the horizontal component of the reaction of the bottom of the hole, or $F_2$

CD is the weight W of the part of the string located under MN

DE is the buoyancy $B_1$

EF is the buoyancy $-B_2$

If the cross-section MN is taken higher on the drilling string, we should consider also the force F, i.e. the reaction of the wall of the hole on the buckled pipe. But let us consider first the theoretical case of buckling which would occur outside the hole, in which case $F = 0$.

From the construction of Figure 22, we may determine the force FA representing the reaction of the part of the drilling string above MN on the portion below. This force has two components:

FG is the shearing force, and GA is the compression (or tension, according to its direction).

Consider a cross-section M'N' somewhere above MN. Then the forces CD (weight of the portion located below M'N') and DE (buoyancy $B_1$ or weight of displaced fluid) corresponding to the new cross-section are larger than the forces corresponding to the cross-section MN. However, the ratio of these two forces remains the same and is equal to the ratio of densities of steel and mud. Therefore, instead of forces CD and DE, we shall consider directly the force CE as being equal to the weight of the drilling string under the cross-section, on condition that we multiply this weight by $\frac{\Delta_S - \Delta_M}{\Delta_S}$

($\Delta_S$ and $\Delta_M$ designate the specific gravities of steel and mud)

For the cross-section M'N', the force EF is smaller than the corresponding force for the cross-section MN. But EF is perpendicular to the shearing force FG and, consequently, the value of FG is independent of EF. The final conclusion is then, that as far as the formula (15), i.e., the shearing force, is concerned, we may not consider the buoyancy at all, on condition that we consider the density of the drilling string material reduced in the ratio $\frac{\Delta_S - \Delta_M}{\Delta_S}$

The vectorial equation

$$\overline{AB} + \overline{BC} + \overline{CE} + \overline{EF} + \overline{FG} + \overline{GA} = 0$$

gives, by projecting all the vectors on the axis MN:

$$AB \sin \alpha - BC \cos \alpha - CE \sin \alpha - FG = 0$$

Then, the shearing force FG is equal to:

$$FG = (AB - CE) \sin \alpha - BC \cos \alpha$$

Since $\alpha$ is, in actual conditions in the hole, very small, we may put $\cos \alpha = 1$ and $\sin \alpha = \tan \alpha$. Then the last equation becomes: shearing force

$$A = FG = (AB - CE) \tan \alpha - BC \quad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

Let p designate the weight of the drilling string per unit of length multiplied by $\frac{\Delta_S - \Delta_M}{\Delta_S}$ as previously explained.

Let $X_1$ and $X_2$ designate respectively the values of X for the two ends of the drilling string, Then

$$X_1 = -\frac{W_1}{p} \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

$$X_2 = \frac{W_2}{p} \quad \ldots\ldots\ldots\ldots\ldots\ldots (18)$$

Then the formula (16) may be written as follows:

Shearing force

$$A = [W_2 - p\,(x_2 - x)] \tan \alpha - F_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (19)$$

Substituting (18) in (19) and replacing $\tan \alpha$ by $-\frac{dY}{dX}$, we obtain $A = -pX\frac{dY}{dX} - F_2$ and substituting this last expression in (15)

$$EI\frac{d^3Y}{dX^3} + pX\frac{dY}{dX} + F_2 = 0 \ldots (20)$$

We have thus obtained the differential equation of the buckled drilling string. By properly choosing the unit of length, the equation may be put in a simpler form:

FIGURE 21

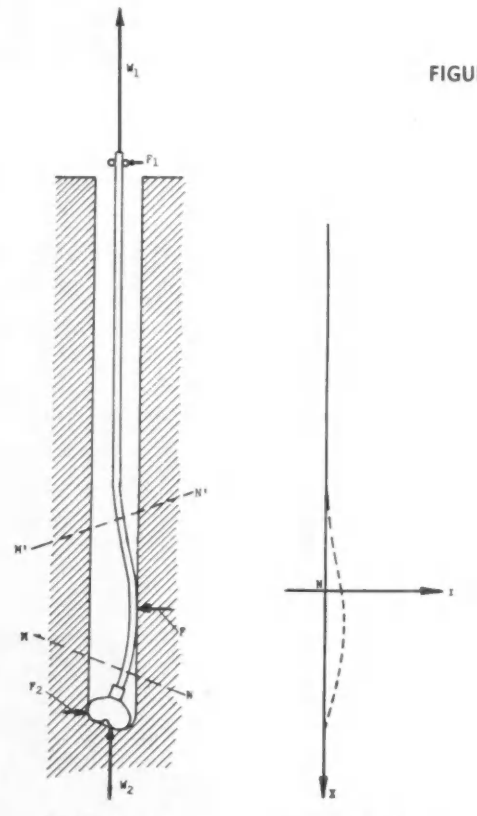
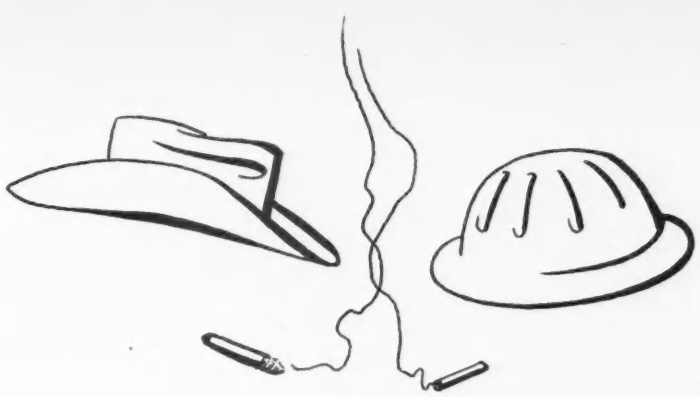


FIGURE 19



FIGURE 20

FIGURE 22



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Put $X = mx$ ..... (21)
and $Y = my$ ..... (22)

where m is a constant which will be chosen later.

Then

$$\frac{dY}{dX} = \frac{dy}{dx} \quad \text{..... (23)}$$

$$\frac{d^2Y}{dX^2} = \frac{1}{m}\frac{d^2y}{dx^2} \quad \text{..... (24)}$$

$$\frac{d^3Y}{dX^3} = \frac{1}{m^2}\frac{d^3y}{dx^3} \quad \text{..... (25)}$$

Substituting the expressions (21), (23) and (25) in the equation (20), we obtain:

$$\frac{d^3y}{dx^3} + \frac{p}{EI}m^3x\frac{dy}{dx} + \frac{F_2}{EI}m^2 = 0 \quad \text{..... (26)}$$

The value m should be chosen so that

$$m^3 = \frac{EI}{p} \quad \text{..... (27)}$$

The expression (27) explains the formula (1) used in the first part of this article. Let c be defined as follows:

$$c = \frac{F_2}{pm} \quad \text{..... (28)}$$

Substituting (27) and (28) into (26), we obtain

$$\frac{d^3y}{dx^3} + x\frac{dy}{dx} + c = 0 \quad \text{..... (29)}$$

Substituting the expressions (24) and (27) in (14) we obtain:

$$M = pm^2\frac{d^2y}{dx^2} \quad \text{..... (30)}$$

Where M designates the bending moment.

Let us adopt a system of consistent units in which:

The unit of X and Y is a foot

The unit of $W_1$, $W_2$, $F_2$, F, etc. is a lb.

The unit of p is a lb/ft.

The unit of E is a $\frac{\text{lb.}}{(\text{Foot})^2}$

The unit of I is a $(\text{Foot})^4$

The unit of M is a Foot $\times$ lb.

The formula (27) shows that m is measured in feet. Then the expressions (21), (22), (23), (30) and (28) show that x, y, $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and c are dimensionless. Consequently, the analysis made with x, y, $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and c will be altogether general and independent of the type of the drilling string and drilling fluid.

### Solution of the Differential Equation

Let z designate $\frac{dy}{dx}$

$$z = \frac{dy}{dx} \quad \text{..... (31)}$$

Substituting (31) into (29), the differential equation becomes

$$\frac{d^2z}{dx^2} + xz + c = 0 \quad \text{..... (32)}$$

The variable x can be expressed in form of power series, i.e.,

$$z = \sum_{n=0}^{n=\infty} a_n x^n \quad \text{..... (33)}$$

and substituting (33) in equation (32), we obtain

$$\sum_{n=0}^{n=\infty} n(n-1)a_n x^{n-2} + \sum_{n=0}^{n=\infty} a_n x^{n+1} + c = 0 \quad \text{..... (34)}$$

This expression is a polynomial of powers of x. The expression (34) must be satisfied for any value of x

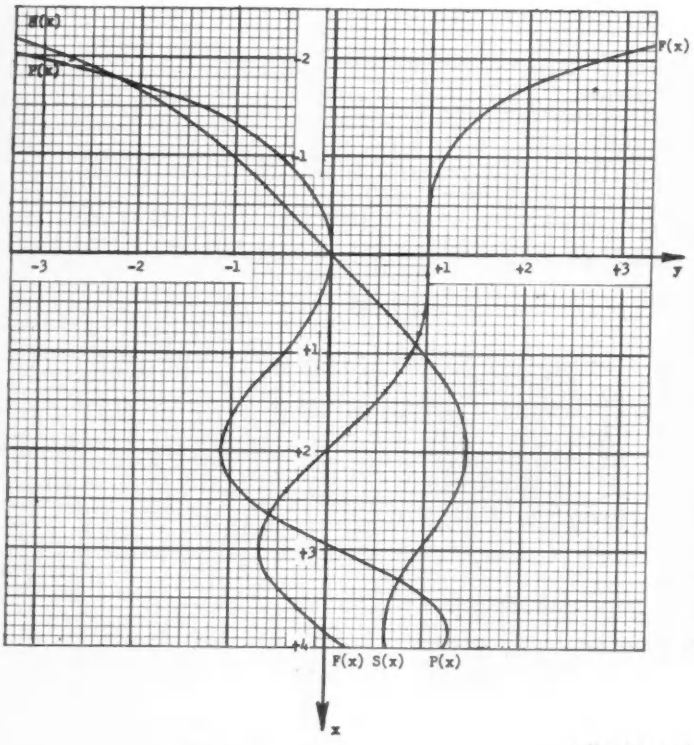
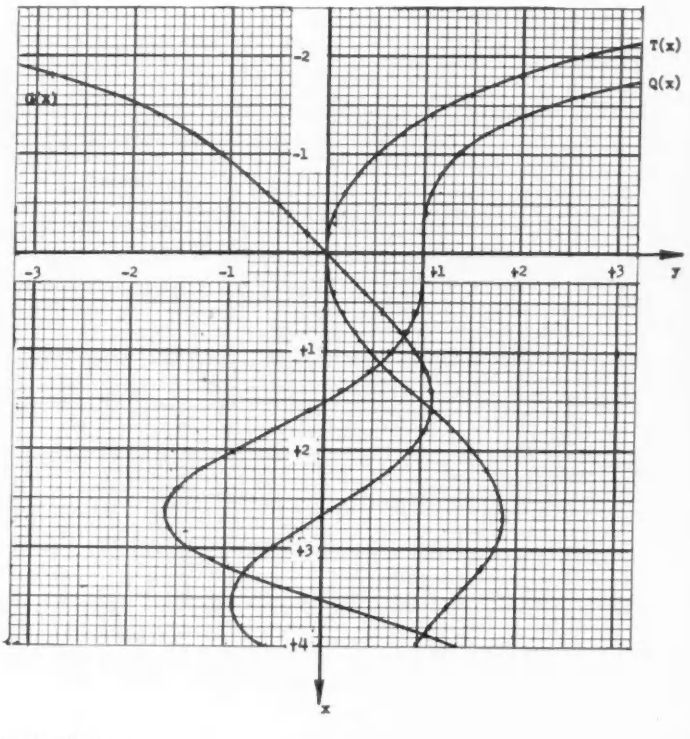


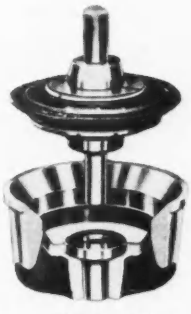

FIGURE 23. Functions F(x), P(x), and S(x).




(All units are dimensionless)

FIGURE 24. Functions G(x), Q(x) and T(x).

# PRECISION TEAMWORK WINS!



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and, therefore, the coefficient of $x^0$, $x^1$,$x^2$,$x^3$,$x^4$, etc. must all be equal to zero. We obtain thus the following expressions:

$$\begin{aligned}&(\text{coefficient of } x^0) = 2a_2 + c = 0\\ &(\text{coefficient of } x^1) = a_0 + 2\cdot 3a_3 = 0\\ &(\text{coefficient of } x^2) = a_1 + 3\cdot 4a_4 = 0\\ &(\text{coefficient of } x^3) = a_2 + 4\cdot 5a_5 = 0\end{aligned}$$

Consequently, $a_0$, $a_1$, $a_2$, $a_3$, $a_4$ etc. may all be expressed as functions of $a_0$, $a_1$ and c. Substituting these expressions in (33), we find the general solution of the differential equation

$$z = a_0\left[1 - \frac{x^3}{2\cdot 3} + \frac{x^6}{2\cdot 3\cdot 5\cdot 6} - \frac{x^9}{2\cdot 3\cdot 5\cdot 6\cdot 8\cdot 9} + \cdots\right] + a_1x\left[1 - \frac{x^3}{3\cdot 4} + \frac{x^6}{3\cdot 4\cdot 6\cdot 7} - \frac{x^9}{3\cdot 4\cdot 6\cdot 7\cdot 9\cdot 10} + \cdots\right] - \frac{c}{2}x^2\left[1 - \frac{x^3}{4\cdot 5} + \frac{x^6}{4\cdot 5\cdot 7\cdot 8} - \frac{x^9}{4\cdot 5\cdot 7\cdot 8\cdot 10\cdot 11} + \cdots\right] \quad \cdots\cdots (35)$$

Putting in the equation (35) $a_0 = a$, $a_1 = b$ and expressing z by $\frac{dy}{dx}$ we obtain equation (37) below. By integrating and taking the derivative of (37), we obtain respectively, as shown below, the equations (36) and (38)

$$y = aS(x) + bT(x) + cU(x) + f \quad \cdots\cdots (36)$$

$$\frac{dy}{dx} = aF(x) + bG(x) + cH(x) \quad \cdots (37)$$

$$\frac{d^2y}{dx^2} = aP(x) + bQ(x) + cR(x) \quad \cdots\cdots (38)$$

In the equations (36), (37) and (38) following designations are made:

f is an integration constant

$$S(x) = x\left[1 - \frac{x^3}{2\cdot 3\cdot 4} + \frac{x^6}{2\cdot 3\cdot 5\cdot 6\cdot 7} - \frac{x^9}{2\cdot 3\cdot 5\cdot 6\cdot 8\cdot 9\cdot 10} + \cdots\right] \quad (39)$$

$$T(x) = x^2\left[\frac{1}{2} - \frac{x^3}{3\cdot 4\cdot 5} + \frac{x^6}{3\cdot 4\cdot 6\cdot 7\cdot 8} - \frac{x^9}{3\cdot 4\cdot 6\cdot 7\cdot 9\cdot 10\cdot 11} + \cdots\right] \quad (40)$$

$$U(x) = -\frac{x^3}{2}\left[\frac{1}{3} - \frac{x^3}{4\cdot 5\cdot 6} + \frac{x^6}{4\cdot 5\cdot 7\cdot 8\cdot 9} - \frac{x^9}{4\cdot 5\cdot 7\cdot 8\cdot 10\cdot 11\cdot 12} + \cdots\right] \quad (41)$$

$$F(x) = 1 - \frac{x^3}{2\cdot 3} + \frac{x^6}{2\cdot 3\cdot 5\cdot 6} - \frac{x^9}{2\cdot 3\cdot 5\cdot 6\cdot 8\cdot 9} + \cdots\cdots (42)$$

$$G(x) = x\left[1 - \frac{x^3}{3\cdot 4} + \frac{x^6}{3\cdot 4\cdot 6\cdot 7} - \frac{x^9}{3\cdot 4\cdot 6\cdot 7\cdot 9\cdot 10} + \cdots\right] \quad (43)$$

$$H(x) = -\frac{x^2}{2}\left[1 - \frac{x^3}{4\cdot 5} + \frac{x^6}{4\cdot 5\cdot 7\cdot 8} - \frac{x^9}{4\cdot 5\cdot 7\cdot 8\cdot 10\cdot 11} + \cdots\right] \quad (44)$$

$$P(x) = -\frac{x^2}{2}\left[1 - \frac{x^3}{3\cdot 5} + \frac{x^6}{3\cdot 5\cdot 6\cdot 8} - \frac{x^9}{3\cdot 5\cdot 6\cdot 8\cdot 9\cdot 11} + \cdots\right] \quad (45)$$

$$Q(x) = 1 - \frac{x^3}{3} + \frac{x^6}{3\cdot 4\cdot 6} - \frac{x^9}{3\cdot 4\cdot 6\cdot 7\cdot 9} + \cdots\cdots (46)$$

$$R(x) = -x\left[1 - \frac{x^3}{2\cdot 4} + \frac{x^6}{2\cdot 4\cdot 5\cdot 7} - \frac{x^9}{2\cdot 4\cdot 5\cdot 7\cdot 8\cdot 10} + \cdots\right] \quad (47)$$

The functions F(x), G(x), P(x) and Q(x) may be expressed in form of Bessel functions of fractional orders 1/3, —1/3, 2/3 and —2/3.

$$F(x) = \frac{1}{2}\cdot 3^{2/3}\,\Gamma\frac{5}{3}\,x^{1/2}\,J_{-1/3}\left(\frac{2}{3}x^{3/2}\right) \quad \cdots\cdots (48)$$

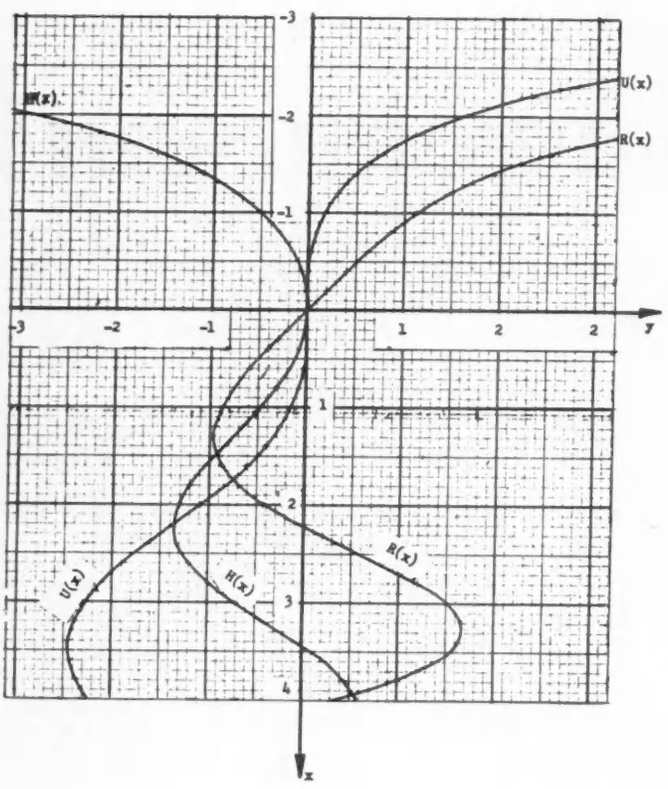


FIGURE 25. Functions H(x), R(x) and U(x).

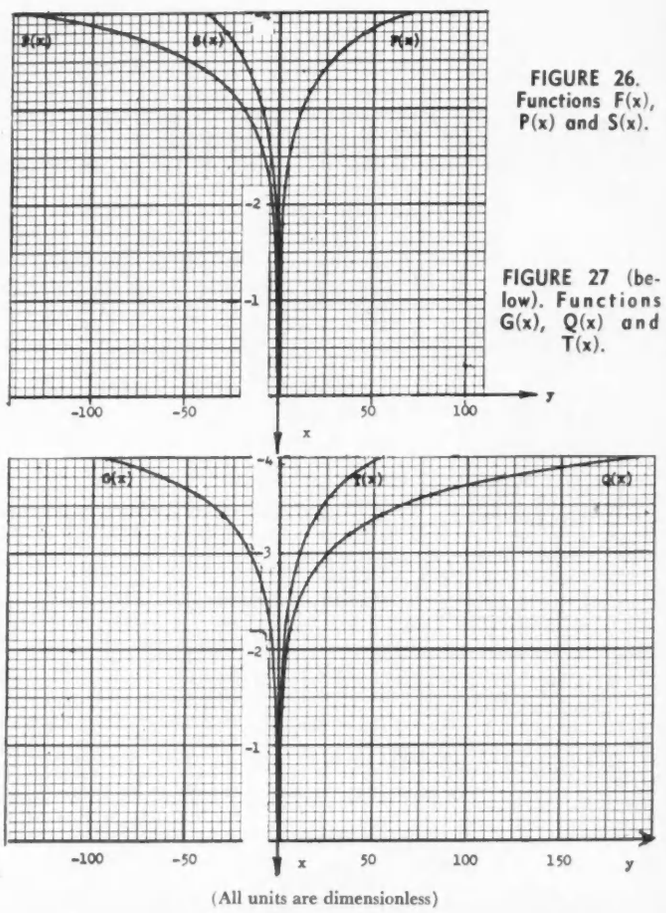


FIGURE 26. Functions F(x), P(x) and S(x).

FIGURE 27 (below). Functions G(x), Q(x) and T(x).

(All units are dimensionless)

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$$G(x) = 3^{1/3}\,\Gamma\left(\frac{4}{3}\right) x^{1/2} \int_{+1/3}\left(\frac{2}{3} x^{3/2}\right) \quad \ldots\ldots(49)$$

$$P(x) = \frac{1}{2} \cdot 3^{2/3}\,\Gamma\left(\frac{5}{3}\right) x \int_{+2/3}\left(\frac{2}{3} x^{3/2}\right) \quad \ldots\ldots(50)$$

$$Q(x) = 3^{1/3}\,\Gamma\left(\frac{4}{3}\right) x \int_{-2/3}\left(\frac{2}{3} x^{3/2}\right) \quad \ldots\ldots(51)$$

Complete tables of Bessel functions of fractional orders have been made available.[5] For the negative values of x, the corresponding Bessel functions of the second kind must be used. The functions S(x), T(x), U(x), H(x) and R(x) have been calculated by series, the convergence of which is fairly satisfactory. The computation has been made for a range of x between —4 and +4. The results are plotted on Figures 23 to 28.

Since the differential equation (29) is of the third order, its general solution (36) contains three integration constants, viz. a, b and f. In addition to the integration constants, the parameter c is unknown, because $F_2$ (i.e. the horizontal component of the reaction of the bottom of the hole on the bit) is also unknown. This parameter can be determined by imposing an additional boundary condition.

## Study of Drilling String Subjected to Critical Weights

### Determination of Critical Weights

Let $x_1$ and $x_2$ designate the values of x for the upper and lower ends of the drilling string respectively. Let $P_1$, $Q_1$, $R_1$, $S_1$, etc. designate the values of the functions P(x), Q(x), R(x) S(x), etc. for $x = x_1$, and $P_2$ $Q_2$, $R_2$, $S_2$ etc. designate respectively the values of the same functions for $x = x_2$.

At both ends of the drilling string, the bending moment is equal to zero (both the bushings and the bit may be considered as hinged ends). Therefore, the formulae (30) and (38) give:

$$aP_1 + bQ_1 + cR_1 = 0 \ldots\ldots(52)$$
$$aP_2 + bQ_2 + cR_2 = 0 \ldots\ldots(53)$$

For both ends $y = 0$, and therefore the formula (36) gives:

$$aS_1 + bT_1 + cU_1 + f = 0$$
$$aS_2 + bT_2 + cU_2 + f = 0$$

By eliminating f between the two last equations and rewriting the equations (52) and (53) we get the following set of three equations in which a, b and c are unknown.

$$\begin{cases} aP_1 + bQ_1 + cR_1 = 0 \ldots(52) \\ aP_2 + bQ_2 + cR_2 = 0 \ldots(53) \\ a(S_1 - S_2) + b(T_1 - T_2) + c(U_1 - U_2) = 0 \ldots(54) \end{cases}$$

Since the second members of all three equations of the set are equal to zero, the solution of the set has a physical meaning only if its determinant is equal to zero.

$$\begin{vmatrix} P_1 & Q_1 & R_1 \\ P_2 & Q_2 & R_2 \\ (S_1 - S_2) & (T_1 - T_2) & (U_1 - U_2) \end{vmatrix} = 0. \quad \ldots\ldots(55)$$

The expression (55) is the relation between $x_1$ and $x_2$ which must be satisfied for the buckling to occur. By trial and error method it was found that the expression (55) may be represented by a series of curves. Two of these curves, designated by the numerals 1 and 2, are drawn on Figure 29. They correspond to buckling of the first and second order respectively.

For the interpretation of Figure 29, it should be remembered that $x_1$ (the ordinate) is the distance from the neutral point to the top of the hole and $x_2$ the distance from the neutral point to the bit. This latter distance is proportional to the weight on bit $W_2$. Figure 29 shows that when the absolute value of $x_1$ is small, i.e., when the hole is very shallow, the pipe requires a larger weight on bit in order to buckle. When the hole is deeper, the critical value of the weight on bit decreases and approaches asymptotically to a certain value. This may also be explained without the previous mathematical analysis. If the upper end of the drilling string is close to the neutral point, the bushings add some rigidity to the string. On the other hand, when the hole is deep enough, a joint of pipe which suffers from buckling does not know whether the joints which remain straight far above it are 1000 or 10,000 feet long.

It is seen from Figure 29, that for $x_1 = -4$ the curves (1) and (2) have almost reached their asymptotic values. Since the 9 functions S(x), T(x), etc., were computed only for the values of x between —4 and +4, the true asymptotic values of $x_2$ are not known. However, we may assume with negligible error that these asymptotic values are reached for $x_1 = -4$. Since in actual drilling conditions $x_1$ is very large we may consider that the asymptotic values have been reached and that the first and second order buckling occur for the values of weight on bit corresponding respectively to $x_2 = 2.04$ and $x_2 = 4.05$.

For all practical purposes we may

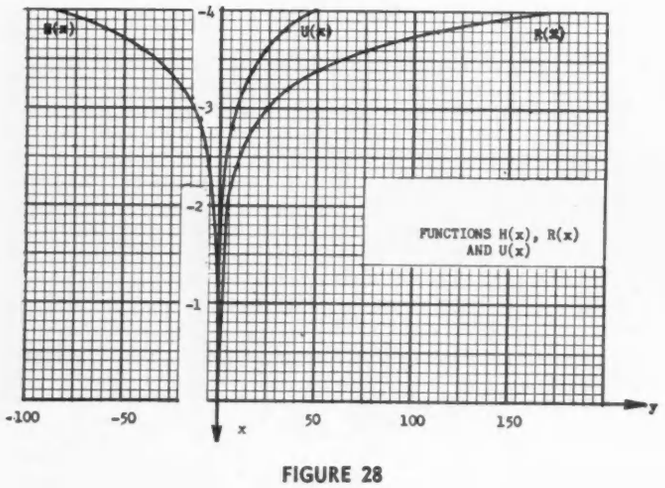



FIGURE 28

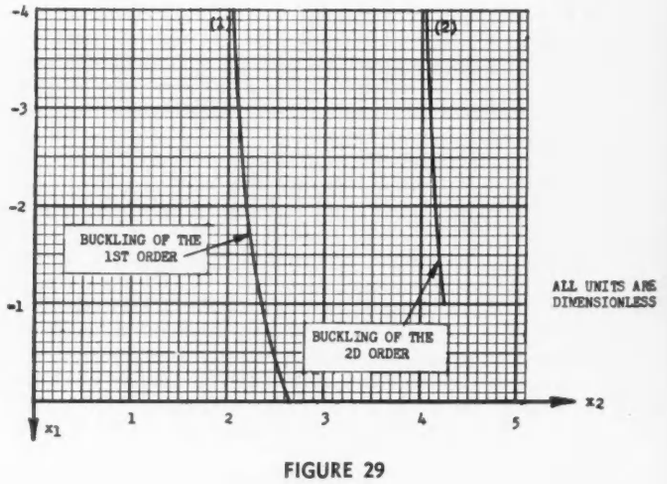
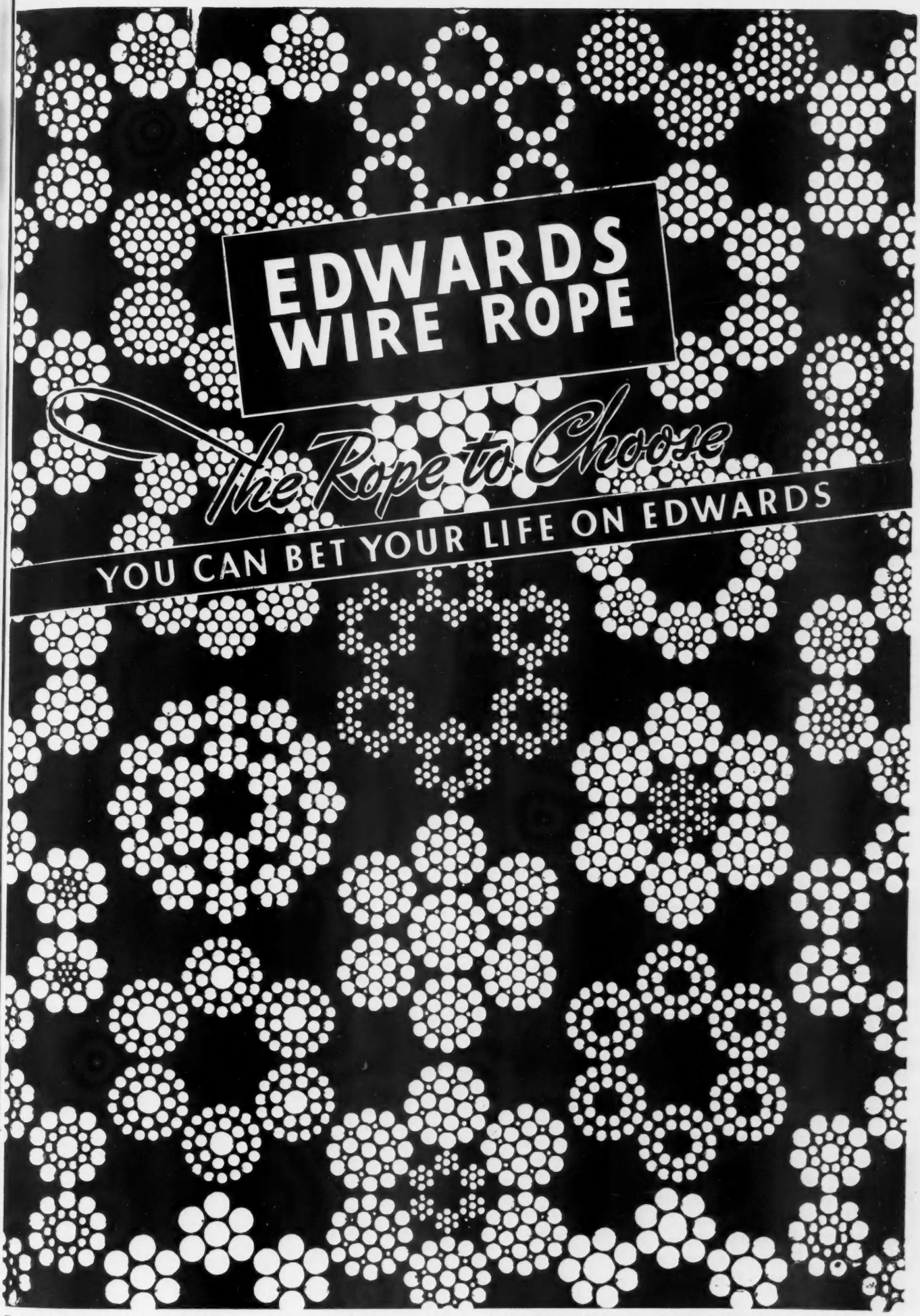



FIGURE 29

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consider the point $x_1$ as being not the upper extremity of the drilling string, but simply a point for which $x_1 = -4$. This point is located almost on the axis of the hole and the bending moment is practically zero.

### Critical Lengths of Stands in Stack

The relationships obtained previously may be used to determine the critical length of stands of pipe stacked vertically in the derrick. Let us assume that a stand of pipe in stack is vertical, has both ends hinged and the whole weight is supported by the lower end. These assumptions are close to the actual conditions.

Which is the maximum length for which the pipe remains straight and does not buckle? The answer is immediate.

$x_1 = 0$ and then we see on figure 29 that $x_2 = 2.65$ ..... (78)
This last value was used in the first part of this paper.

### Shape of the Buckled Drilling String and Distribution of Bending Moments

The critical values of weight on bit having been thus determined, we can investigate at present the shape of the buckled string axis as expressed by the equation (36) and the variation of the bending moments along the pipe as expressed by the equation (38). We must then find the values of a, b, and c, but the set of equations (52), (53), and (54) gives indeterminate values for a, b and c. Then, apparently if we consider the pipe outside of the hole, the buckling once started would not stop. The pipe would bend more and more without reaching any equilibrium. This apparent absurdity is due to the fact that the formula (14) holds true only for small deflections, for which the curvature is equal to $\frac{d^2y}{dx^2}$. For large deflections, for which an equilibrium would be reached, a more complicated formula should be used. But all this is without any practical meaning, because the theoretical equilibrium of the buckled pipe would be reached far beyond the elastic limit of the steel and the pipe would not only become crooked, but broken. Practically such condition never occurs, because the buckling is stopped when the pipe contacts the wall of the hole. This should be taken into account in order to remove the indeterminacy of equations (52), (53) and (54).

We shall determine the point of contact, the abscissa of which will be designated $X_3$. It is obvious that at this point the tangent to the pipe is vertical and Y equal to the apparent radius of the hole. The apparent radius of the hole was previously defined by the expressions (4) and (5).

Since for $x = x_3$ $\frac{dy}{dx} \Gamma = 0$, we have from the equation (37)

$aF_3 + bG_3 + cH_3 = 0$ ..... (56)

The equations (56, (52) and (53) form the following set:

$$\begin{cases} aF_3 + bG_3 + cH_3 = 0 \ldots\ldots (56) \\ aP_1 + bQ_1 + cR_1 = 0 \ldots\ldots (52) \\ aP_2 + bQ_2 + cR_2 = 0 \ldots\ldots (53) \end{cases}$$

which has possible solutions if the following determinant is equal to zero.

$$\begin{vmatrix} F_3 & G_3 & H_3 \\ P_1 & Q_1 & R_1 \\ P_2 & Q_2 & R_2 \end{vmatrix} = 0 \ldots\ldots (57)$$

The expression (57) is the relation between the abscissa $x_3$ of the point of tangency and the abscissas $x_1$ and $x_2$ defined previously for critical conditions.

$P_1$ $Q_1$ and $R_1$ correspond, as explained above, to $x_1 = -4$

$P_2$ $Q_2$ and $R_2$ correspond to the critical values, i.e.

$x_2 = 2.04$ and $x_2 = 4.05$ for the buckling of the first and second orders respectively.

The corresponding values of $x_3$ satisfying the relation (57) were found by trial and error method and are equal to $x_3 = 0.34$ for the buckling of the first order, $x_3 = 0.66$ and $x_3 = 3.36$ for the buckling of the second order.

For $x = x_3$, we have $X = X_3$, $Y_3 = r$ and the formula (22) gives:

$y_3 = \frac{r}{m}$ ..... (58)

For $x = x_1 = -4$, y is equal to zero and therefore the equation (36) gives: $aS_1 + bT_1 + cQ_1 + f = 0$

### Buckling of the First Order

For $x = x_3 = 0.34$, y is equal to $\frac{r}{m}$ and therefore the equation (36) gives $aS_3 + bT_3 + cQ_3 + f = \frac{r}{m}$

Eliminating f between the last two equations and rewriting the equations (52) and (53), we obtain the following set of equations:

$$\begin{cases} a(S_3 - S_1) + b(T_3 - T_1) + c(U_3 - U_1) = \frac{r}{m} \ldots\ldots (59) \\ aP_1 + bQ_1 + cR_1 = 0 \ldots\ldots (52) \\ aP_2 + bQ_2 + cR_2 = 0 \ldots\ldots (53) \end{cases}$$

In these equations $x_1 = -4$, $x_2 = 2.04$, $x_3 = 0.36$. The solution of the set leads to the following values:

$a = 0.161 \frac{r}{m}$ ..... (60)

$b = -0.374 \frac{r}{m}$ ..... (61)

$c = 0.523 \frac{r}{m}$ ..... (62)

Substituting the above values of a, b, and c in the equations (36) and (38) we obtained the values of $y \frac{m}{r}$ (shape of the curve) and $\frac{d^2y}{dx^2} \frac{m}{r}$ (bending moments) for the buckling of the first order. These curves were plotted on Figure 8. The abscissas, instead of being measured as the values of x from the neutral point downward, are measured from the bit upward in the same units as x. The interpretation of figure 8 was given in the part one.

The expression (30) may be transformed as follows:

$M = pmr \left\{ \frac{m}{r} \frac{d^2y}{dx^2} \right\}$

Figure 12 shows that $\frac{m}{r} \frac{d^2y}{dx^2}$ is equal 0.8 and 1.1 for the critical conditions of the first and second orders respectively, which explains the expressions (6) and (7) used in the first part of this article.

### Buckling of the Second Order

A set analogous to the set of equations (59), (52) and (53) may be written. The only difference is that in the equation (59) $\frac{r}{m}$ was replaced by $-\frac{r}{m}$ in order to obtain the curves as drawn on Figure 9, instead of symmetrical curves which we would get otherwise. With $x_1 = -4$, $x_2 = 4.05$ and $x_3 = 0.66$, the solution of the corresponding set of equations gives:

$a = -0.251 \frac{r}{m}$ ..... (63)

$b = 0.227 \frac{r}{m}$ ..... (64)

$c = -0.436 \frac{r}{m}$ ..... (65)

The curves of $y \frac{m}{r}$ and $\frac{d^2y}{dx^2} \frac{m}{r}$ for the second order buckling were plotted on Figure 9, the interpretation of which was given in the first part of this article.

How to do it!

# DRILLING HINTS

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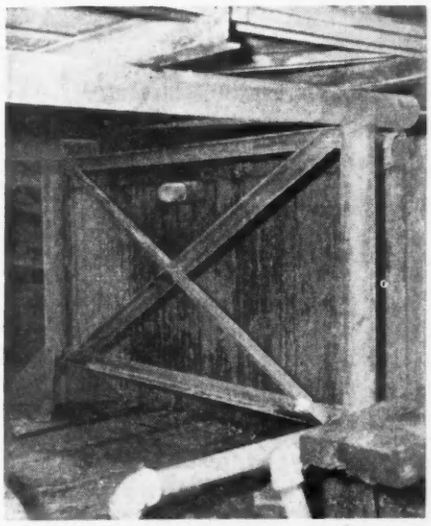
## HOW TO—
## Build Sectionalized Platform for Tank



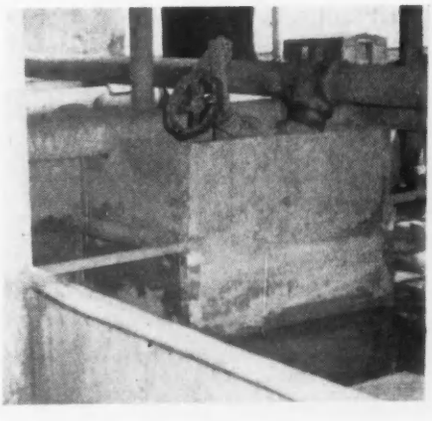
An elevated tank platform which incorporates features that contribute to easier handling and transporting in the field is employed by one drilling contractor. Constructed of drill pipe and angle iron materials, the platform has the general appearance of most such units; however, it is made so that it can be broken down and carried as four flat sections merely by removing a few bolts. The legs and principal upper horizontal members of the platform are of 4½-inch drill pipe. The end sections of the unit are trusses made of 2½-inch angle iron. Each end section is attached, with four ¾-inch bolts, to ⅜-inch thick ears welded to the drill pipe legs. Triangular sections of 5 x 12-inch I-beam welded at four points around the base of the legs provide very sturdy footings for the rack. The base segments are cut in equilateral-shaped pieces in order to eliminate waste of material in the cutting of the I-beam.

The platform described is approximately six feet square and has an over-all height of 54 inches. The same construction can apply, however, to a platform of any size. The ability to break the rack down quickly into four nearly flat pieces, and the ease with which the segments can be hauled and re-assembled at the next location, easily repay the slight extra cost involved in providing the sectionalized feature.

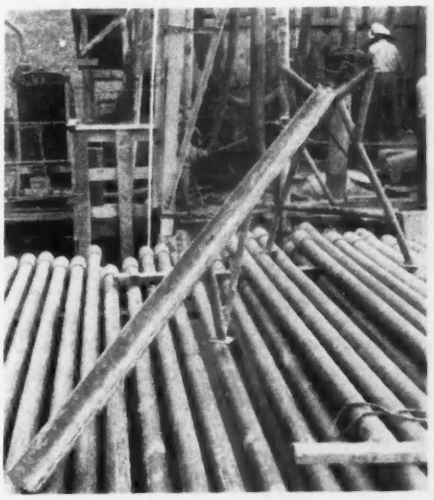
## HOW TO—
## Improve Method of Slugging Barytes

The practice of slugging drill pipe with barytes prior to making a trip may be improved through the installation of a trap door-equipped box in the suction pit. The slug box is welded to the base plate of the steel mud tank with the pump suction flanged to the side of the box. While normal drilling operations are in progress, the lever actuated trap door remains in an elevated or open position, thus permitting mud from the tank to enter the pump suction.

When it becomes necessary to trip the pipe, the slug box door is closed. Then, barytes is mixed in the hopper and ultimately released into the slug box through the open hopper line valve shown. The concentrated barytes slug, available at the pump suction, is then displaced to the desired depth within the drill pipe. The inauguration of this practice provides a more heavily concentrated barytes slug, eliminates an unbalancing of the mud in the pits and reduces the necessity of chasing the drill pipe. By permitting the pipe to be pulled dry, this technique provides an accountable saving of drilling fluid.



## HOW TO—
## Facilitate Lowering Drill Pipe on Rack



When drill pipe or drill collars are laid down, considerable care must be taken to assure that they are not bent excessively as they are skidded out on to the walk to the point where the buggy can take them and carry them on out. A practice gaining increasing favor is that of providing a chute down which the joint can be skidded at a more gentle angle and which provides support for the pipe through a good part of its descent. One such chute, of simple construction and of somewhat longer length than some, is shown.

The chute itself is a half-section of seven-inch casing slightly more than 13 feet long. It is supported at the well end by a pair of well-braced 48-inch legs of two-inch pipe and in the approximate center by a shorter leg of the same material. A guide roller is built into the head of the pipe slide. The chute is anchored temporarily by driving several spikes through holes in the steel plate feet welded to the bottom of the pipe legs.

The longer the chute the better chance there is of not injuring the pipe and the sooner the elevators can be released. Such a chute is relatively inexpensive and can be stored in any out-of-the-way place near the rack when not in use.

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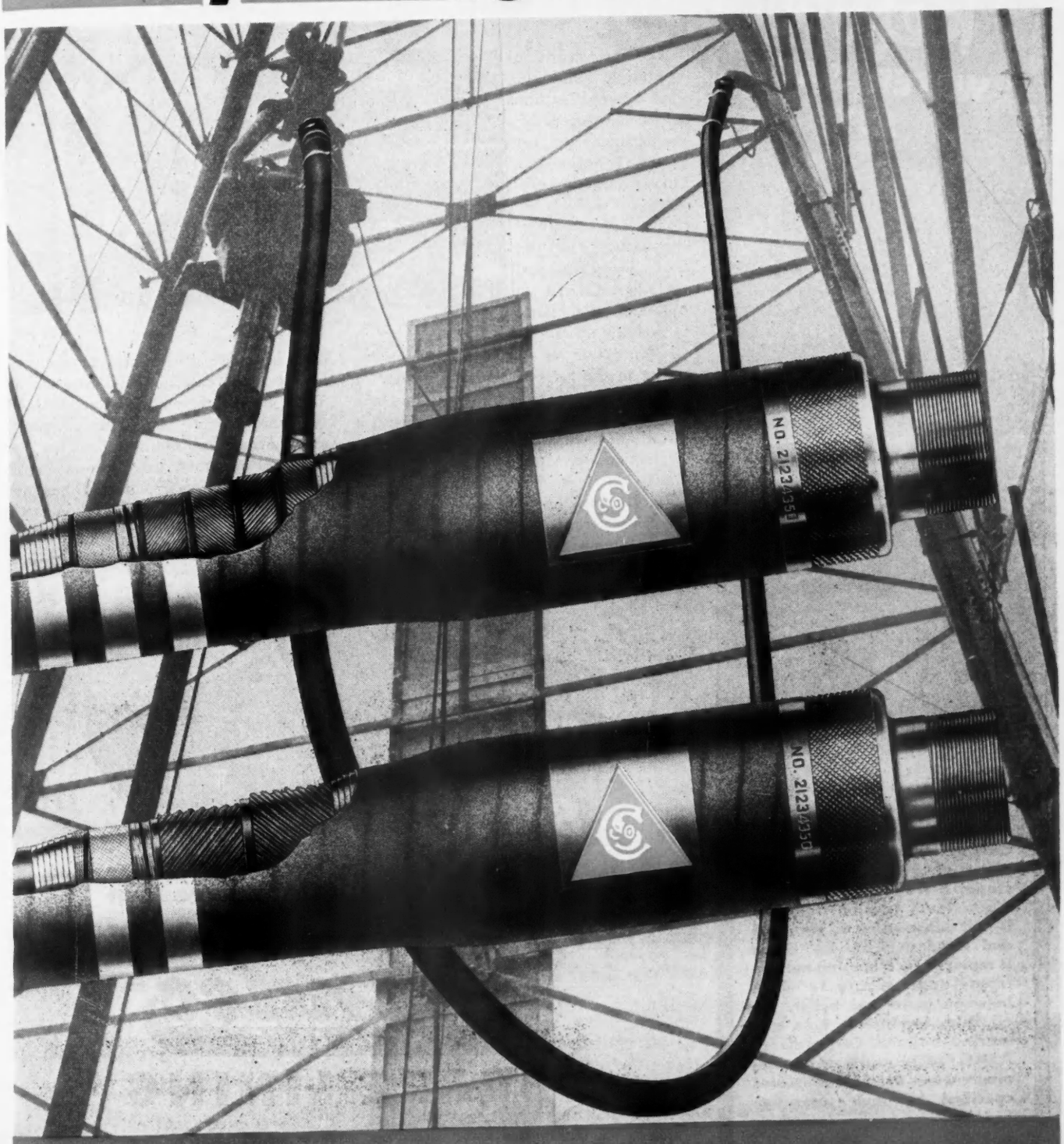


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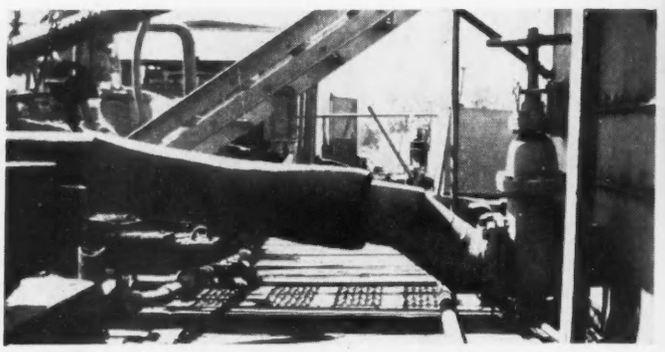
# HOW TO—Strengthen Suction Hose



The more nearly in a straight line the mud pump suction hose can be operated, the longer its expected service life. One contractor provides for any variation in alignment of the suction inlet on his mud pumps and the suction outlet on his steel mud tanks by welding up an offset connection on the flange which attaches to the gate on the tank outlet.

This offset connection carries the bare nipple over which the end of the hose is forced and then, through a series of angular sections, provides a drop of approximately the suction pipe diameter.

By turning the flange on the end of this offset connection through the required number of bolt holes, the outlet may be made up to provide maximum lift, as is the case in the illustration. Or, if the tank and pump suction are not in the same vertical plane, the rotation of the flange before bolting it to the fixed flange of the tank valve allows any desired combination of lift and horizontal offset to be secured and the hose distorted only enough to accommodate the slight misalignment required.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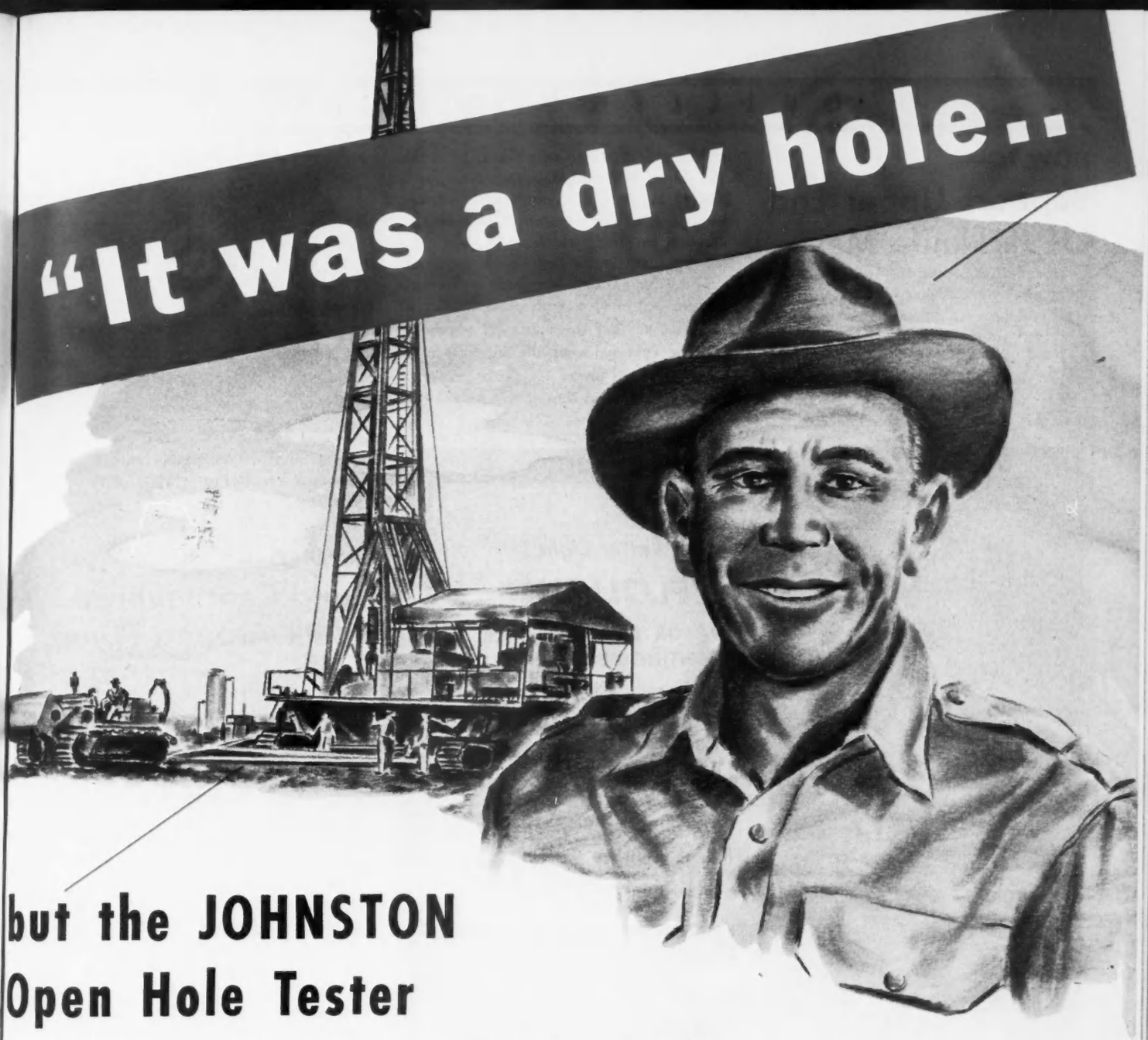


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HOW TO—

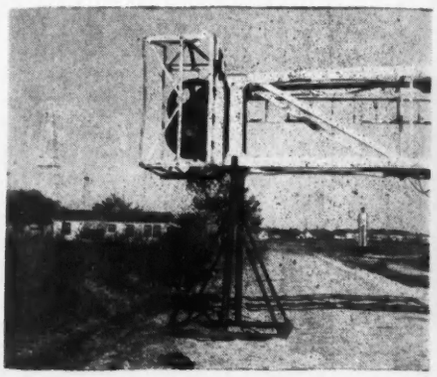
## Support Upper End Of Jackknife Mast

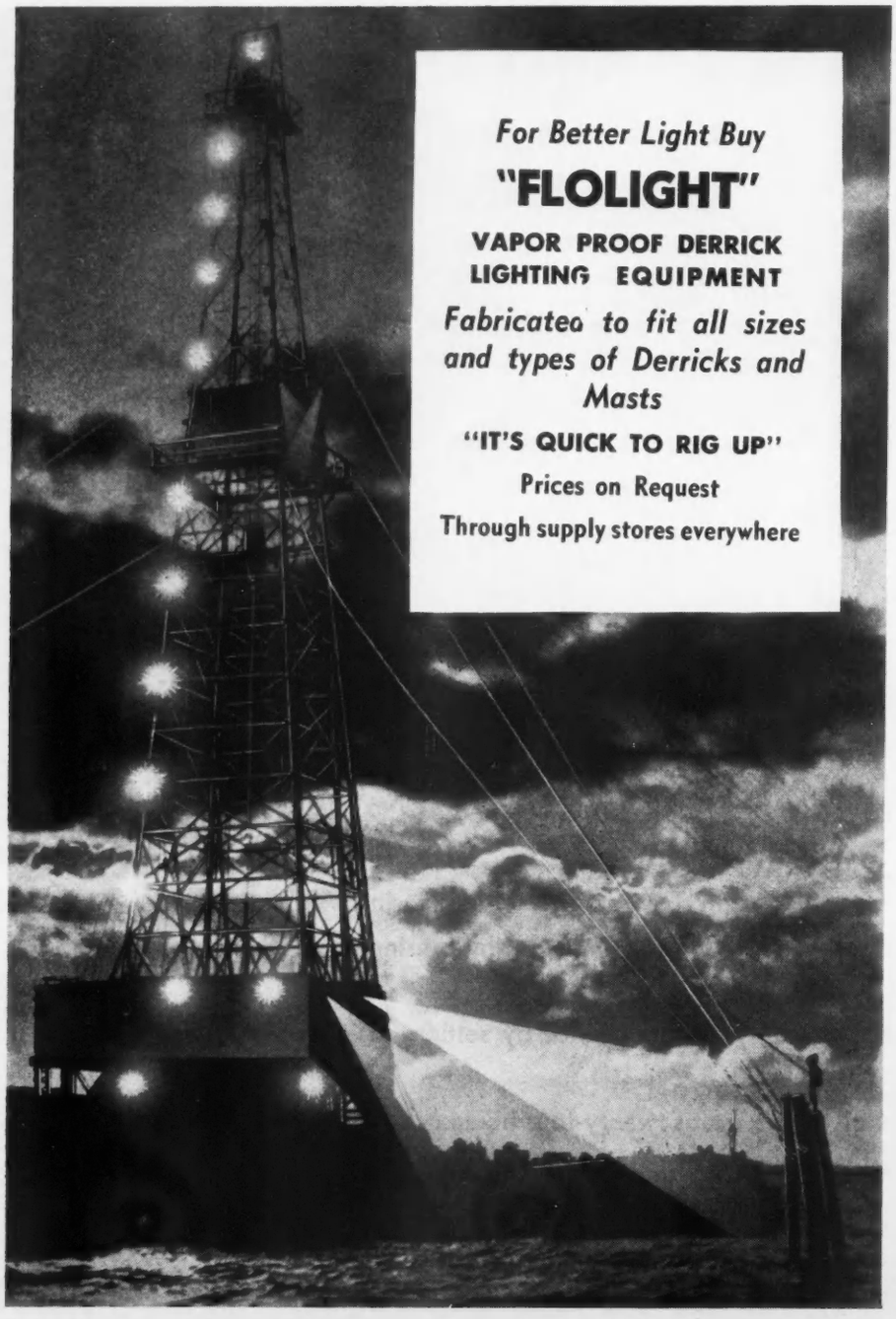
To simplify placing the truck under the upper end of the mast and its attached crown block, one drilling contractor uses a welded stand or support on which the mast is lowered, instead of allowing the end to descend all the way to the ground.

The support is made high enough so that the truck bed can be spotted under the mast, and also so that when, as in the case shown in the photograph, the mast is lowered across a roadway, traffic will not be shut off. The clearance as shown is above seven feet, which will allow cars and light trucks to pass under the mast.

The upper cross member, a six-inch I-beam, is provided with guide angles at the ends, so that the mast will automatically be centered over the supports as it is lowered into place.

The rectangular base, formed of 2½-inch pipe, is set on a square or set of separate timbers when the mast is to be supported on boggy ground. The pipe alone forms sufficient bearing when solid ground.

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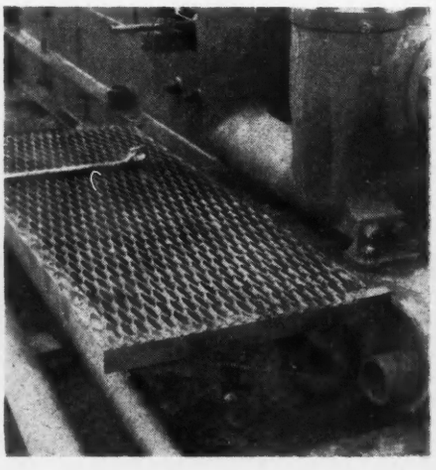
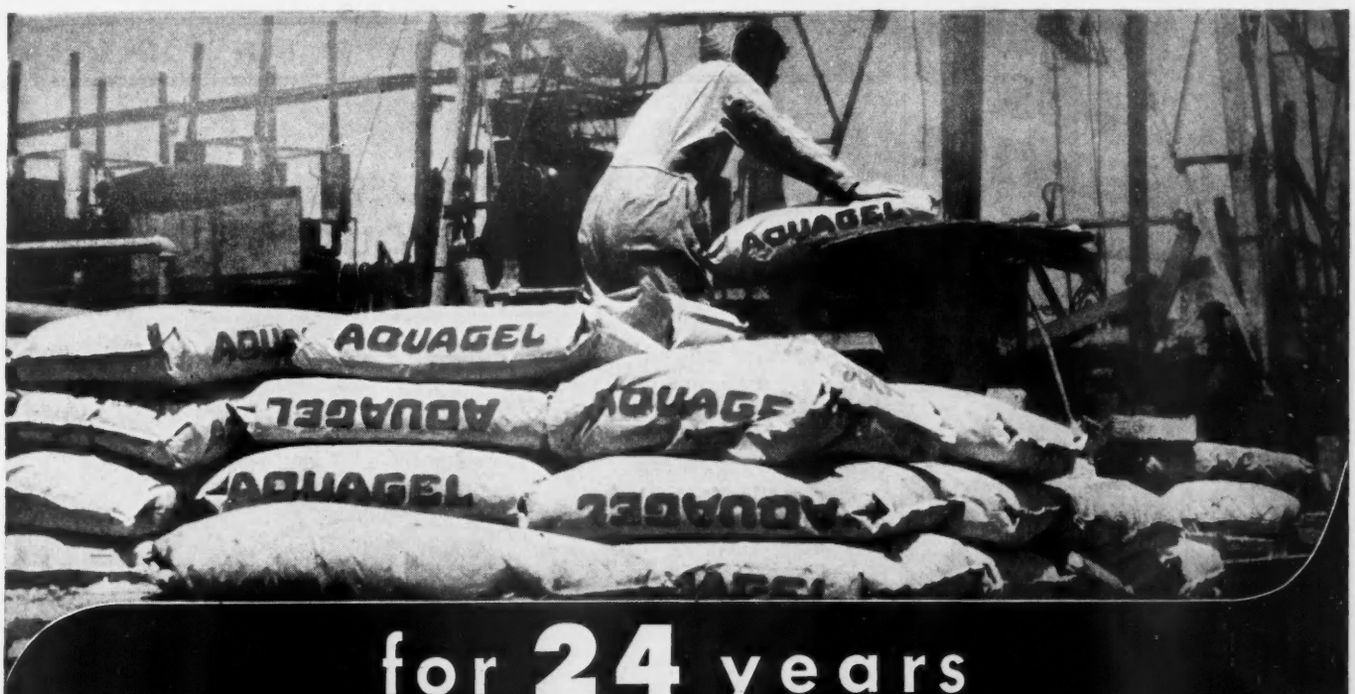
HOW TO—

## Build Cantilevered Walk Around Pump

An efficient, yet inexpensive method of attaching a walkway or working platform to the side of the slush pump skid base is shown. Of cantilever construction, the framework of the platform is designed so that it can be attached or detached quickly. Welded to the top surface of the two inside corners is a short piece of two-inch flat steel bar, the outer end of which is bent downward through 90 degrees so it can be hooked over and into a slot cut through the top surface of the skid base I-beam. The platform pictured is approximately six feet long by 30 inches wide. Angle iron used is 2½- x 2-inch material and the surface is decked over with heavy expanded metal. Aside from having the desirable feature of being removable merely by lifting the hooks out of the slots, the platform provides a slightly higher level from which men can work on the pump valves. The absence of outer supporting legs allows pipe lines to be laid alongside the pump base. Such a platform is easily adaptable to the conditions existing on any piece of skid-base mounted equipment.



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1. **HIGH YIELD**—One ton of AQUAGEL yields 100 barrels of 15-centipoise drilling mud in fresh water. This high yield means a lower cost per barrel of drilling mud.

2. **LOW WATER LOSS** — AQUAGEL muds have inherent low water losses. Chemical treatment will result in further water loss reduction. Where minimum water losses are required AQUAGEL muds are the ideal base muds. The colloids in AQUAGEL are compatible with all other materials used in fresh water drilling mud.

3. **THIN FRIABLE FILTER CAKE**—AQUAGEL muds deposit thin filter cakes having low permeabilities. These thin filter cakes promote freedom of pipe movement and offer minimum resistance to removal upon completion of the well.

4. **REDUCES ABRASION** — AQUAGEL in the mud produces a film of slippery gel which lubricates everything it touches. Thus sand and cuttings are made less abrasive, liner life is extended, drill pipe torque is reduced, and the movement of tools is facilitated.

5. **CHECKS MILD CIRCULATION LOSSES**—The efficient AQUAGEL filter cake deposited on the face of a coarse sand or other mildly permeable formation frequently will be all that is needed to stop loss of fluid from the hole.

6. **UNEXCELLED SUSPENDING QUALITIES** — AQUAGEL is unexcelled in preventing settling of weight material, holding cuttings in suspension, transporting cuttings out of the hole.

7. **MUD CONDITIONER**—AQUAGEL in the mud provides the particular type of colloidal material which is essential to the maintenance of good mud properties.

8. **UNIFORMITY** — Only the finest bentonites qualify for AQUAGEL. Baroid maintains the highest standards of product quality control in the industry. Operators can rely on AQUAGEL'S consistent performance anywhere in the country.

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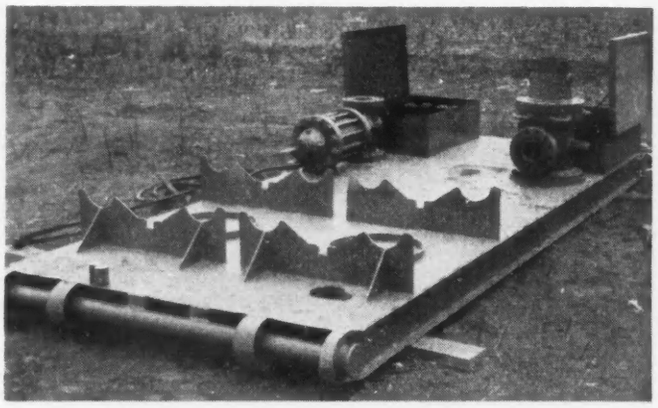
## HOW TO—Move Blowout Preventers

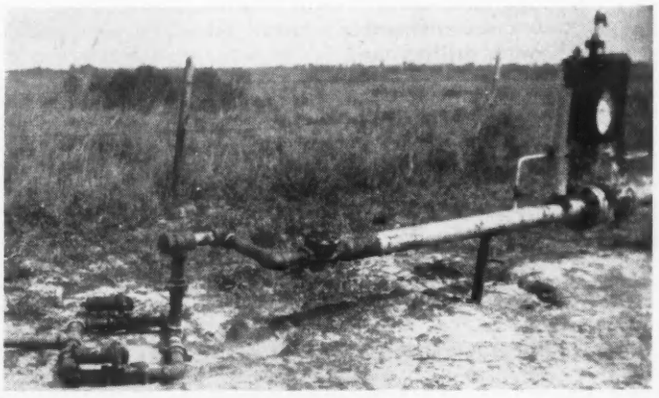


Considerable rigging-up, hauling and maintenance expense can be saved through the systematizing of racking and handling blowout preventer equipment. In providing a single, centralized place where he can safely carry and store such equipment, one drilling contractor fabricated a special platform on which he can mount blowout preventers, spare parts and tools needed in assembling and maintaining the units.

As shown, the rack is made up of a skid base to the top of which is welded a deck of steel plate. To this deck is welded a series of supports or cradles on which the preventers can be laid down. These cradles are made of pieces of half-inch steel plate which have been accurately cut out so that the weight of the units will be evenly distributed and at the same time prevent their rolling off when the platform is picked up and moved. The rack is equipped to handle nearly every type of fitting that likely will be used on a particular rig. Two sturdy all-steel storage boxes, in which are kept packing elements, small tools and spare parts, are welded to the platform at one end of the rack. The boxes, reinforced at the corners with angle iron material, are amply strong to withstand the impact of tools or fittings accidentally lowered or dropped on them.

The saving in hauling and maintenance of the expensive blowout preventer equipment will easily repay the material and labor expended in building the rack.

## HOW TO—Regulate Gas Fuel Flow



To insure flow of gas from the field line to his rig, one contractor utilizes two spring-loaded control units on separate branches of a loop which he introduces into the fuel line downstream of the chart recorder and meter run which show the amount of gas consumed.

Use of the loop and paired control units provides continuous flow of gas to the rig, even should one of the units kick off or become clogged by grit or scale being carried through the line.

Each side of the loop is provided with quick-acting unions so that an impaired control unit can be quickly taken out of service and a replacement, on a section of loop made up to exactly fit the gap left by removal of the other, tied in.

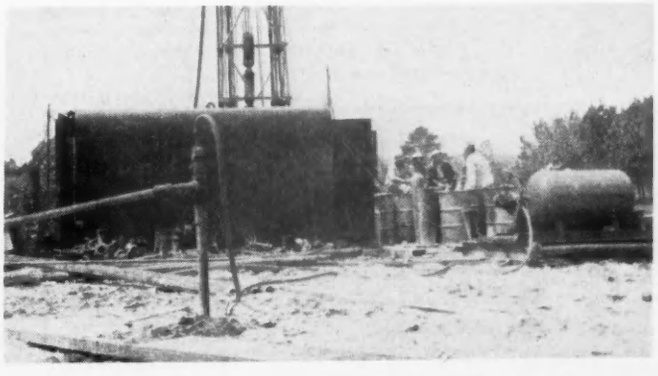
The loop and controls are relieved of possible expansion stresses by a double swing, connected into the gas line between the end of the meter run and the entry into the side of the loop.

# HOW TO—Handle Cumbersome Pipe

A pipe vise support, combined with a rack to simplify and facilitate threading and handling of long or cumbersome pieces of pipe, can easily be constructed out of a few pieces of 2- and 2½-inch pipe. Designed to save time when odd jobs of this type must be done at the rig, this rack has two desirable features: (1) it can support any length of pipe and (2) it can be broken down quickly for easy transporting from one location to another at the rig or between wells. As shown, the two end sections are separated by an eight-foot tongue, a length of pipe on which is mounted a sliding U-shaped rack which can be moved along and locked with a set screw to support the end of the piece of pipe being cut or threaded. A union placed close to the vise end of this tongue can be broken to permit nesting or easier handling of the assembly. The vise is bolted to a broad base of half-inch plate, the area of which is sufficient to provide a small space for keeping hand tools, oil and for working on fittings.

The utility of this device will easily be seen during the operation of rigging up tools. The procedure of depending on temporary vises will be eliminated, and the rigging-up program should be somewhat faster.

# HOW TO—Operate Water Well Jet



Air jammers, ordinarily employed for operation of clutches, power slips and tongs, may easily be used to jet water wells. Initially, the water well illustrated was cased with three-inch pipe. A final installation of one-inch macaroni tubing was provided to facilitate efficient jetting. The lower end of the macaroni string must be designed so that a quarter-inch orifice looks up the hole. In this manner, it is possible for air, which is injected through the macaroni string, to jet water to the surface.

An inspection of the photograph will reveal that the macaroni string is supported by means of a three-to-one swage. At this point, a rubber hose may be attached to introduce air from the compressor to the well. Utilization of rubber hose eliminates the time-consuming task of laying iron pipe.

The compressor system can be relieved of this increased demand through the installation of a larger air volume tank.

The advantage of this application is obvious in operating areas where it is not permissible to jet water wells with available lease gas.

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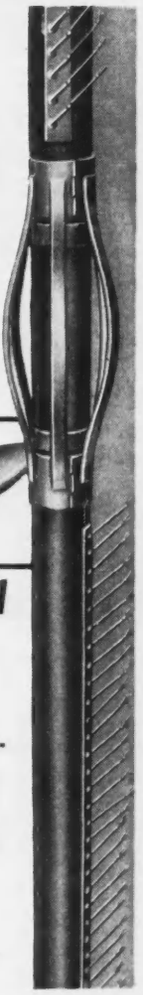

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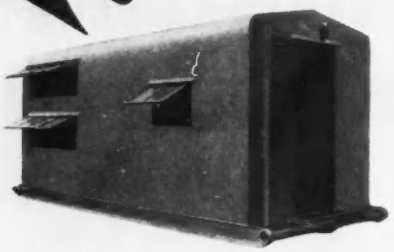

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# HOW TO—Minimize Mud Splatter

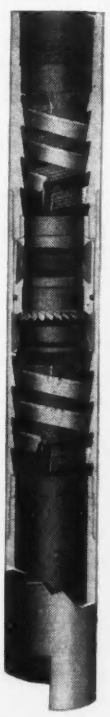
The delivery line from the mud-mixing pump at one drilling well originally was brought in over the steel tank in which the mud was stored, but the flow from the end of the pipe would tend to break and when the mud level was close to the pipe there would be considerable splatter. This not only wasted valuable mud, but also kept the walkway and the vicinity of the pit covered with mud and made walking near the pit hazardous.

By welding a collar around the end of the delivery pipe the mud emerging from the delivery line was protected from wind currents, and the flow was directed solidly into the mud below. When the level rose to close to the collar, the wide expanse of steel intercepted the splashes of mud, and kept down the former agitation immediately around the pipe.

The collar or flange was cut from quarter-inch steel plate, and welded to the end of the delivery pipe by loosening the union farther back in the line and rotating the end until the downward facing end was upright above the pit.

With the collar in place, even on very windy days, the walkway remains clean, and it is the usual practice to flush down the walks only when preparing for a move —as against the almost daily hosings required before attaching the collar.

The BEST OVERSHOT is the RIGHT BOWEN OVERSHOT



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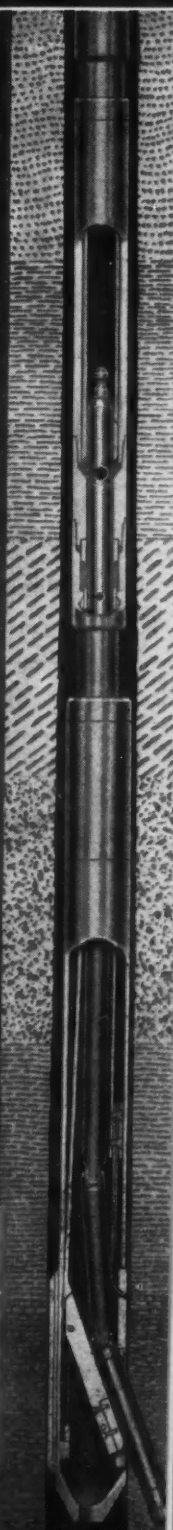

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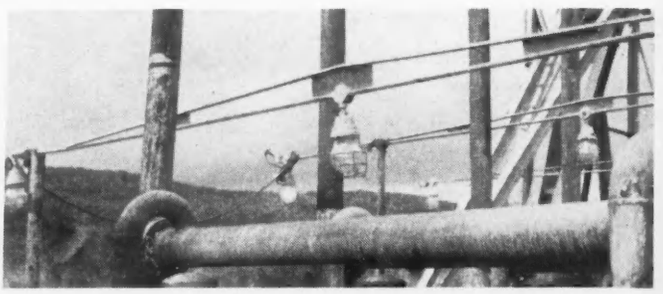
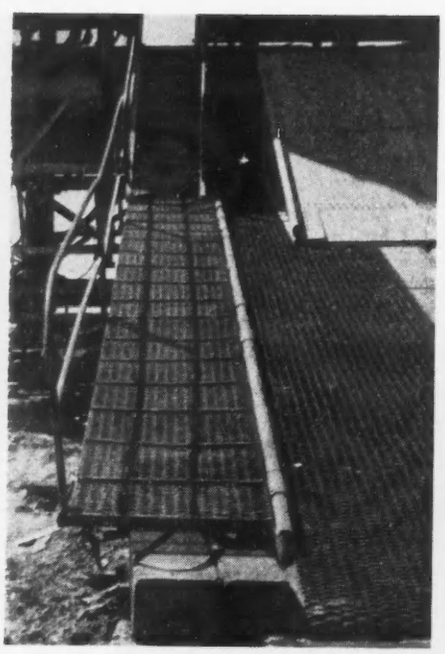
# HOW TO—Support Overhead Lights



An improved overhead light support, one which requires only a length of conduit, a slightly longer length of one-inch angle iron and a few pieces of light-weight steel plate, is employed to good advantage by a drilling contractor. As illustrated, the rack is built in the form of a truss which has sufficient strength that no sag occurs in the center of the span reaching across the drilling engines and transmission case. Two of these supports, each having three lights attached to it, provide ample light for servicing and repairing of the equipment.

The small amount of materials and time required to fabricate the racks make their use practical where there is no means of suspending lights from an overhead structure or roof. The units pictured are supported on each end by posts having U-shaped slots cut in their top.

# HOW TO—Add Walk to Truck Ramp



Access to the derrick floor may be provided through the installation of a hinged walkway on the truck ramp. Structurally, the walkway consists of a two-inch pipe frame which has been cross-braced with quarter-inch reinforcing rod and floored with expanded metal. Welded guard rails are fabricated of one-inch pipe and have been designed to fold under the walkway for dismantling.

The illustration shows placement of sleeve hinges along the two-inch ramp guard to permit folding the walkway over on the ramp for transportation. The actual hinging of the hand rail is accomplished in a comparable manner.

Equipping a rig with this standard equipment provides additional man hours formerly invested in the construction and dismantling of wooden walkways. The problem of rig transportation may be somewhat minimized through the use of unitized equipment.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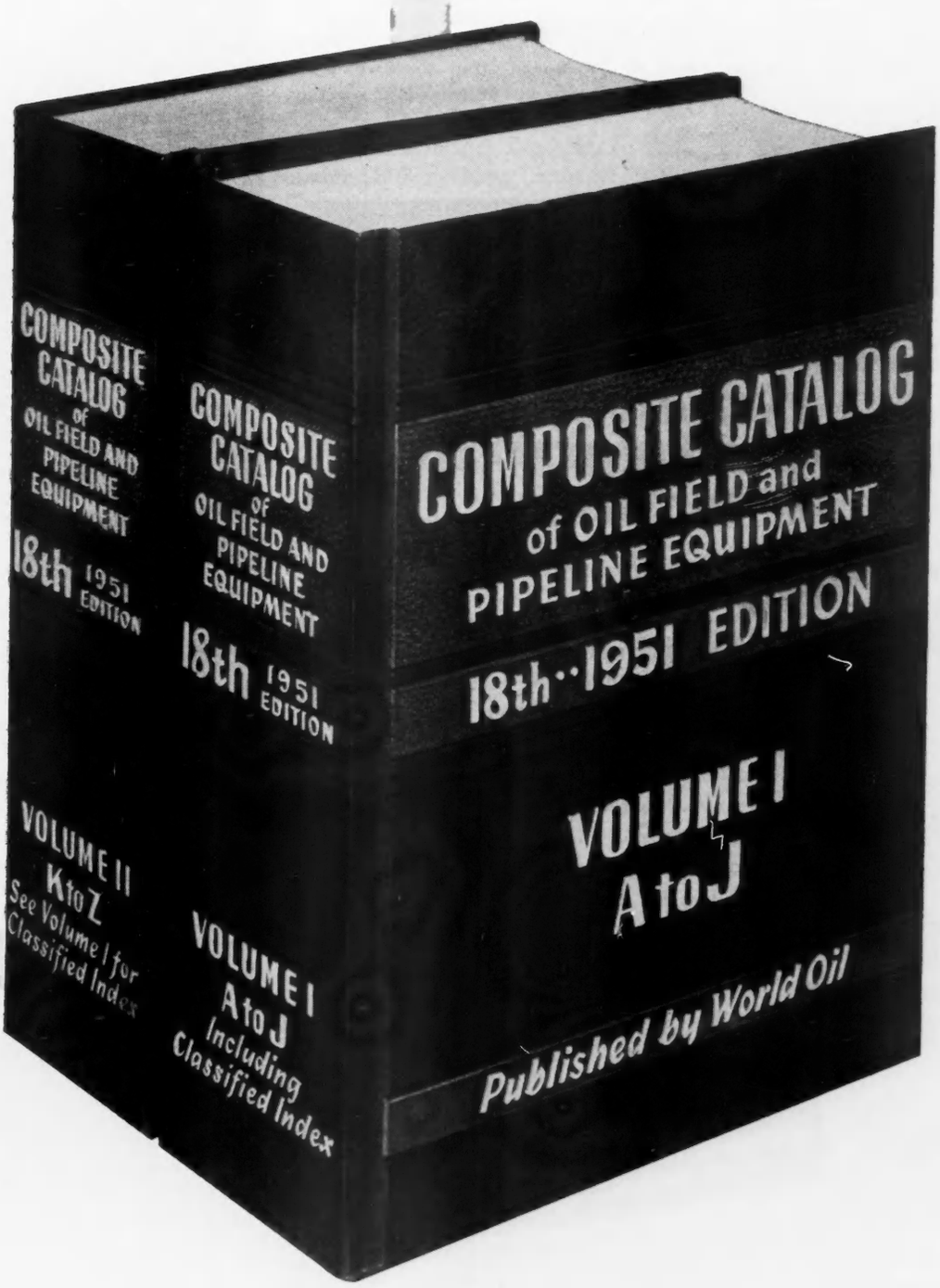
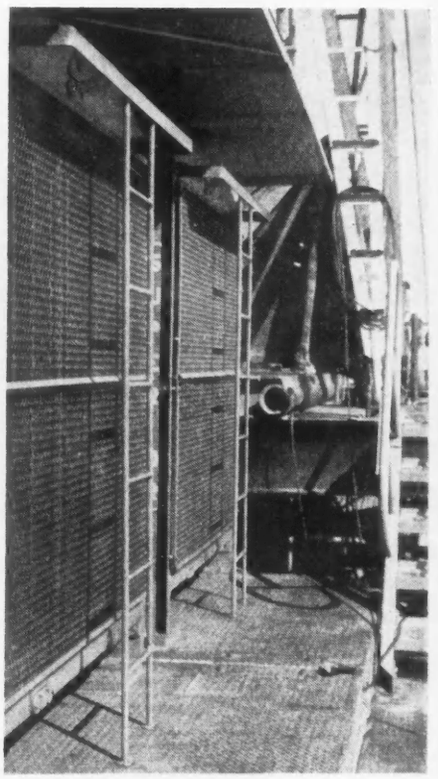



## USE THIS UNIVERSAL EQUIPMENT GUIDE

# HOW TO—Attach Ladder for Inspection of Radiator

On power rigs where the radiators for the units are too high for inspection from the walkway, some means must be provided to enable the motorman to check water level in the radiators.

One contractor uses light ladders welded from sucker rod, one for each radiator. The top of the ladder is welded to a support of ½ x 2-inch strap steel which is made long enough to extend across the entire radiator front. Offsets and short ears turned parallel with the main strap allow this support to be fastened to the radiator housing with cap screws.



The bottoms of the ladders are inserted into pairs of holes burned through the floor plates. These holes are spaced so as to be the same distance from the radiator front as the distance between support strap and shell.

Collars, welded to the ladder legs about an inch from the bottoms of the paired rods, take the load and prevent the ladders from being forced out of place vertically when used.

If the radiator guard must be removed and the cooling core removed, the ladder can be dismounted simply by taking out the two cap screws in the strap support and lifting the ladder feet from the holes in the floor.

Permanently installed ladders provide another important factor that may well be considered of additional advantage; that is, the extension of safety features.

The routine of maintaining radiators often prompts the engine man to depend on temporary structures such as a nail keg or bit box. The use of such a provision often results in serious injury to the employe. Accidents of this nature involve monetary consideration which exceeds the expense of installing permanent ladders.

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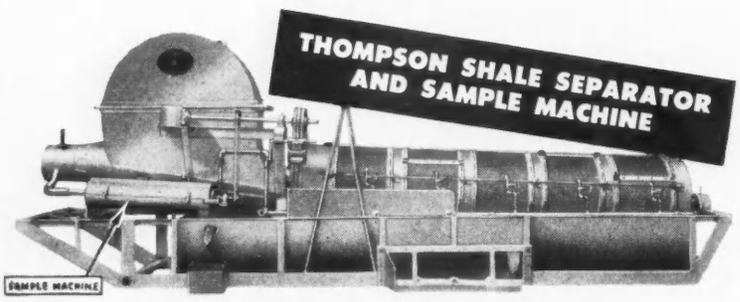


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## A Review of

# Reservoir Engineering

### Part 1

By NORMAN J. CLARK

Petroleum Engineer,
Humble Oil & Refining Company, Houston

DURING recent years a new science has evolved in petroleum production engineering which is now referred to as "Reservoir Engineering." Some authorities think of this new science as the basic petroleum engineering, or at least as being that part of petroleum engineering which identifies it as a separate and individual branch of engineering. This relatively new science deals with the occurrence and movement of fluids in reservoirs and their recovery and is therefore the science of producing oil. It embodies a thorough study and evaluation of all factors affecting the recovery of oil and gas to determine the most efficient and profitable method of production commensurate with the economic trends.

In the 1930's this new science developed rapidly throughout the industry, but the impetus was found principally in the research laboratories of the various oil companies. Since World War II the application of reservoir engineering to field operations and production problems has become more and more widespread throughout the oil industry, and the current trend is toward still more dependence upon the recommendations of personnel trained in the reservoir engineering science to obtain greater recoveries of oil and gas, which in effect increases our known reserves and therefore enhances our national economy.

Just what the subject of reservoir engineering embraces and to what extent it enters into production problems are subjects of widespread speculation by many in the industry, not only from management but also from various staff men, including some petroleum engineers. This appears to be due primarily to the fact that this science is still in its infancy and involves a new technical approach. Undoubtedly, as time passes and a greater knowledge of the scope of reservoir engineering is obtained by engineers and management alike, the relationship of reservoir engineering to production operations will be better understood and the benefits of its application can be realized on a wider scale.

**HERE IS a simplified explanation of a relatively complicated science. The basic types of petroleum reservoirs are treated separately and in combination, and accompanied by easy-to-understand diagrams. The maze of complicated mathematical formula along with related charts and graphs have been eliminated, and reservoir behavior discussed in a manner familiar to oil men. This paper was presented before the October 19, 1950 meeting of the Houston Chapter, API, through whose permission it is published.**

It is the purpose of this paper therefore to present a simplified review of reservoir engineering. This review will include discussions of (1) reservoir engineering data; (2) behavior of various types of reservoirs and methods of their study; and (3) verification and interpretation of the results of reservoir analyses. The subject is very broad and to discuss it in one paper has required that only the basic concepts be presented.

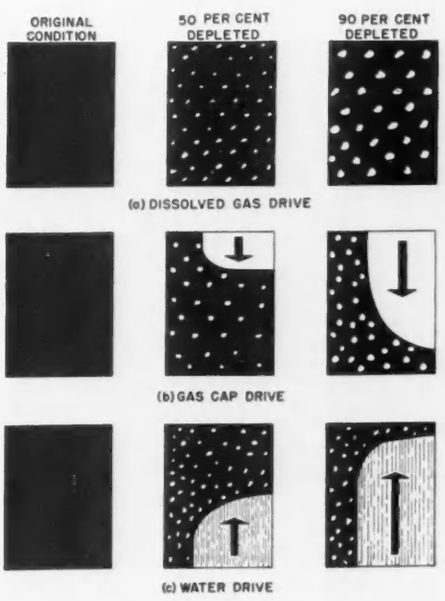



**FIGURE 1. Oil zone depletion under different drives (after Buckley and Craze).**

## *Reservoir Engineering Data*

Production practices that promote maximum recovery of oil from reservoirs are usually determinable on a firm basis only after lengthy reservoir studies are made with such studies being accurate only to a degree commensurate with the completeness and reliability of the information available concerning the producing reservoir. Most reservoir problems deal with future operations in the light of past performance of the reservoir, and a considerable amount of all types of reservoir data are often necessary before a satisfactory solution may be made. Accurate and dependable basic data are therefore the cornerstone of any sound reservoir engineering study. There are four broad types of data that the engineer must have in conjunction with reservoir studies. These include data concerning the reservoir rock, the properties of fluids in the reservoir rock, a pressure history of the reservoir, and a production history of the reservoir. The reservoir rock and fluid data are usually obtained during the development stage of the reservoir and the pressure and production data are obtained over the entire period of operations.

### Properties of Reservoir Rock

The required data concerning the reservoir rock include estimates of the total rock pore volume in both the oil and gas zones of the reservoir. These volumes are obtained by means of contour and isopach, or net pay thickness

maps of the reservoir. To these are applied proper values for porosity and connate water content in determining total volumes of hydrocarbons in place originally in the reservoir. It is necessary therefore to have the best available quantitative information on the porosity, permeability, both absolute and relative permeability ratio, and connate water in the reservoir rock. In addition it is desirable to have qualitative information on the character and homogeneity of the reservoir and the continuity between the reservoir and the adjacent water bearing formation. Coring, drill-stem testing, and various types of logging provide the sources for the data needed in this category.

### Properties of Reservoir Fluids

The fluid properties of the reservoir may be obtained from a laboratory analysis of a subsurface or a recombined oil and gas sample. The more important fluid properties obtained are the hydrocarbon analysis of the reservoir fluids; flash liberation data, including shrinkage factor, dissolved gas-oil ratio, and oil gravity; pressure-volume-temperature or P-V-T data; differential gas liberation data; differential oil shrinkage data; and reservoir fluid viscosity data.

### Production Data

The data on the production history include a tabulation of the periodic production of oil, gas, and water from the reservoir. Total volumes of fluids produced from the reservoir are used for problems dealing with the reservoir as a whole, whereas pre-well production data are used for problems dealing with individual wells. In addition, it is desired to know for each well its productive capacity, location on the structure, and interval of formation perforated.

### Pressure Data

Periodic reliable average reservoir pressures, or at least a reliable trend of average reservoir pressures should be obtained. This periodic pressure history should conform to the periodic production history. For problems dealing with reservoirs as a whole, average reservoir pressures are obtained based on all or some limited number of key wells whereas problems dealing with individual wells require per-well pressure data.

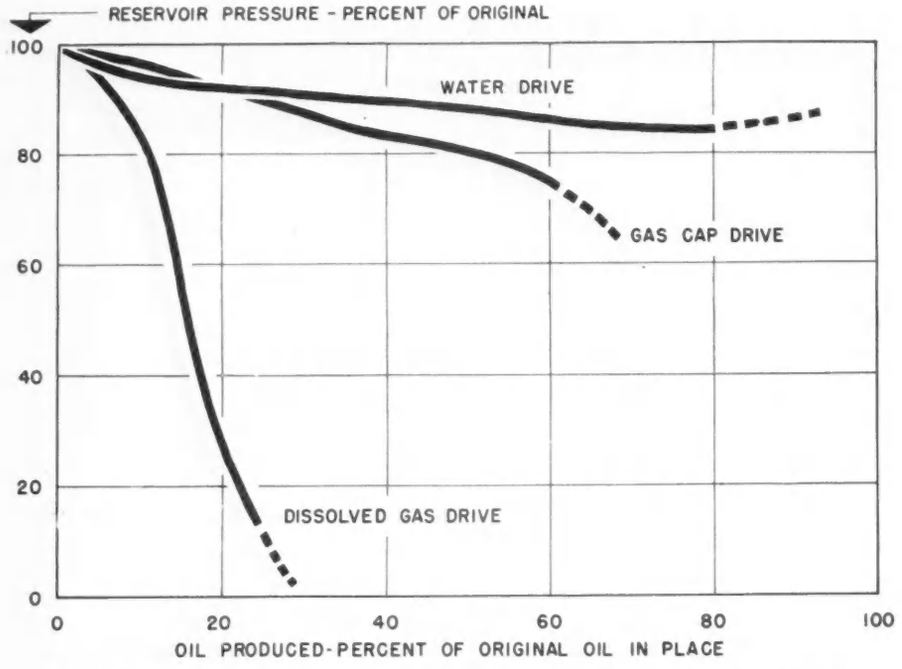



FIGURE 2. Reservoir pressures under various drives (after Buckley and Craze).

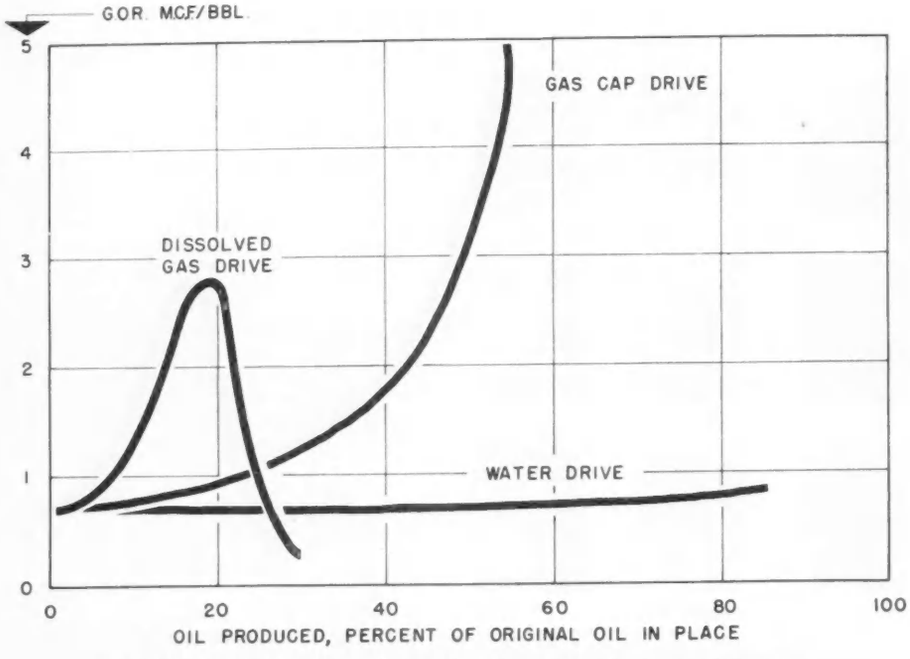



FIGURE 3. Gas-oil ratios under various drives (after Buckley and Craze).

## *Reservoir Behavior and Methods of Study*

The second phase of reservoir engineering deals with the mathematical interpretation of the reservoir changes that take place with production and time.

When a reservoir is discovered, the fluids in the rock pores are at rest. This equilibrium is distributed as production of oil from the rock takes place. When the oil moves out something must take its place. Pressure drops and remaining fluids expand and move toward the point at which oil is removed. Fluid saturations are thereby altered. Different physical changes take place in different reservoirs with similar withdrawals because seldom are two reservoirs found that closely resemble each other in behavior characteristics. These changes depend upon many things but in over-all reservoir performance they depend principally upon the presence of a free gas cap in place over the oil zone, a water basin adjoining the reservoir below and capable of providing water to enter the reservoir when pressure drops in the reservoir, and upon the permeability of the rock both in the oil zone and the adjacent gas and water zones.

Buckley and Craze[1] have pointed out that there are three essentially different types of reservoir drive mechanisms. These three reservoir drive mechanisms are referred to as dissolved gas

drive, water drive, and gas cap drive, and are compared schematically in Figure 1. Any reservoir found in nature may be producing under the influence of any one or a combination of these different drives, and the purpose of reservoir studies is to determine the physical nature of the various types of reservoirs and the manner in which the corresponding drive mechanisms influence reservoir behavior and to determine means for controlling the behavior in order to permit maximum economic return. There have been developed a number of basic tools for use in the determination of the performance of the various types of reservoirs. These tools are mathematical, to be sure, for just as the pipe wrench is the tool of the pipeliner so is the mathematical equation a tool of the engineer.

Usually at least 10 percent of the recoverable oil must be produced from the reservoir before sufficient reservoir life has transpired to permit a complete reservoir performance study. Basically, a reservoir study involves the application of some standardized set of mathematical relations, the terms of which are made up from reservoir, fluid, pressure, and production data, and the calculations of which are made to determine past reservoir behavior. If the behavior that is calculated agrees with the past behavior that is observed for the particular characteristics being studied, then the mathematical interpretation of the reservoir is said to be valid and the set of equations are then used to make predictions. If calculated and observed past behavior does not agree, the mathematical approach must be altered or the data must be reexamined and the correct data utilized so that observed past performance can be duplicated mathematically. Then, and only then, can accurate predictions of future reservoir performance be made utilizing the mathematical equations developed. Several types of machines have been developed for use in reservoir studies to permit rapid mathematical calculations. In many instances the machines permit calculations to be made which otherwise would be too laborious and time-consuming to perform. These machines are electric analyzers, analog devices, digital computers, and potentiometric models. The accuracy and applicability of the results of studies obtained by use of these machines are limited by the accuracy of the data used and the method of calculations set up in the machine just as it is in the case of the laborious pencil and paper method.

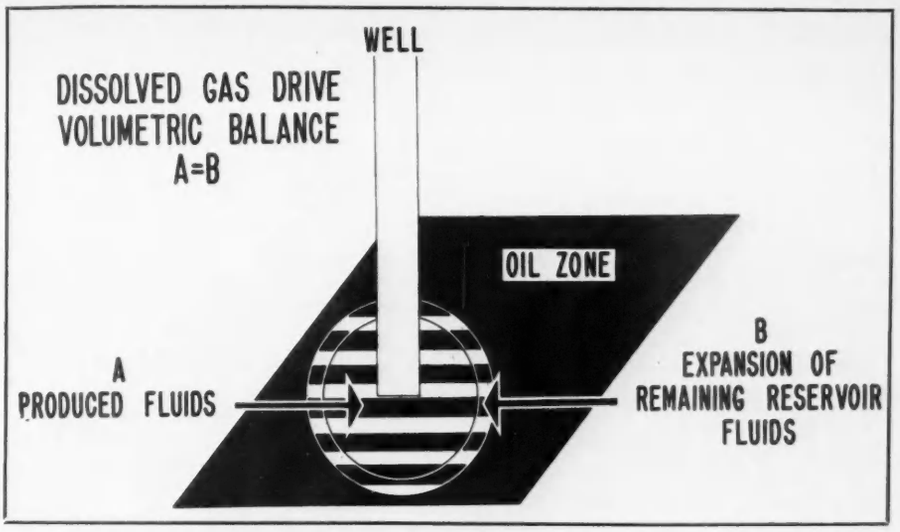



FIGURE 4. Dissolved gas drive reservoir illustrating volumetric balance method of calculating behavior.

The aspects of reservoir performance that are determined by mathematical calculations vary, of course, depending upon the type of drive mechanism active in producing oil from the reservoir. These variations are outlined in the following paragraphs.

### Dissolved Gas Drive Reservoirs

The dissolved gas drive reservoir is considered as a depletion type reservoir because it has no gas cap, is completely isolated from water encroachment, and produces by a process of depletion of dissolved gas. Pressure falls rapidly in

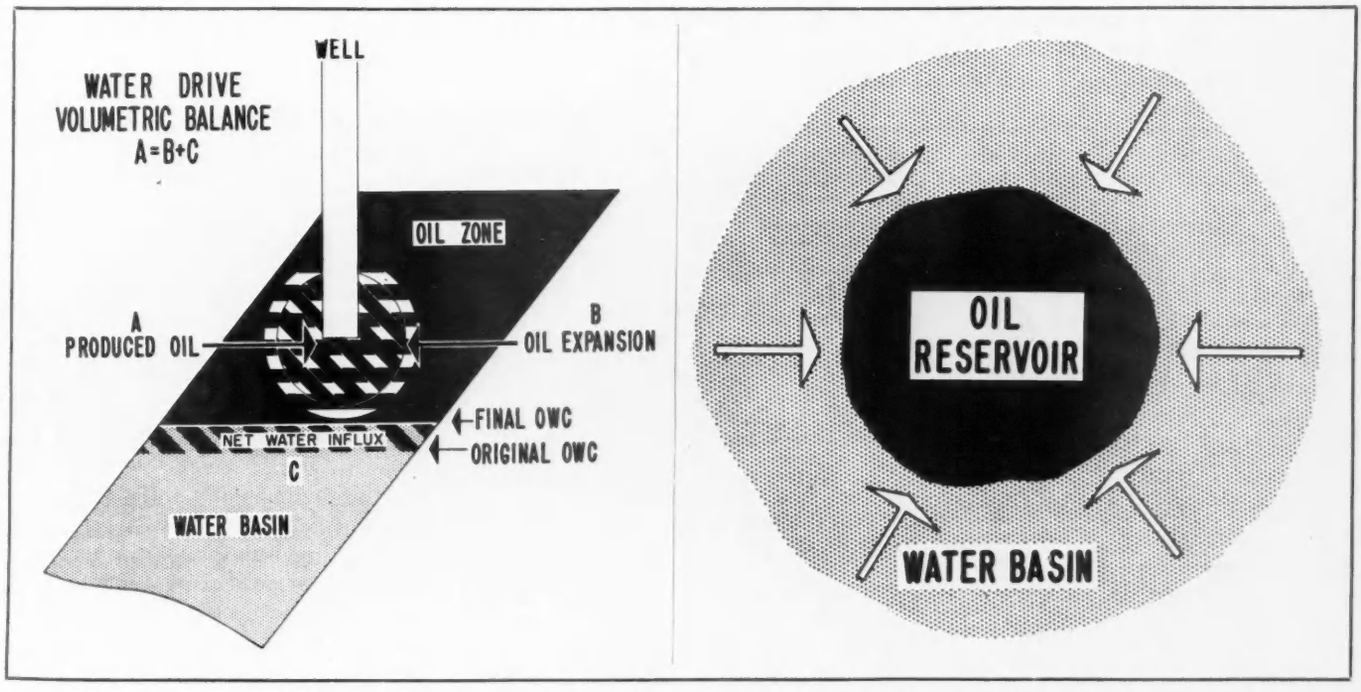



FIGURE 5 (left). Water drive reservoir illustrating volumetric balance method of calculating behavior.
FIGURE 6 (right). Unsteady state radial flow of water into a reservoir.

a dissolved gas drive reservoir (Figure 2). Gas-oil ratios are low at first, then usually increase rapidly to a peak several times the original ratio, and then fall back to a low value once again (Figure 3). Recovery from a dissolved gas drive reservoir under primary recovery or straight production operations where gravitational effects are of no consequence is of the order of 15 to 30 percent of the original oil in place.

Mathematical relations for the analysis of the dissolved gas drive reservoir were published by Muskat.[2] Similar relations for the analysis of the performance of dissolved gas drive reservoirs are utilized by various engineers, but all the processes are essentially the same. These processes merely utilize some form of volumetric or material balance and may be either trial and error or direct calculations depending upon the assumptions involved. The volumetric balance is a mathematical statement balancing the volume of materials withdrawn with an equal volume of materials which takes their place. In this case, the materials wtihdrawn are oil and gas and the materials taking their place are expanded volumes of remaining oil and gas in the reservoir. Almost all of the expansion comes from the gas that is liberated from the oil throughout the reservoir. Figure 4 illustrates this basic relation. The attendant pressure is determined by means of the expansibility of the remaining oil and gas and the gas-oil ratio is determined by means of relative permeability and fluid saturation relations.

### Water Drive Reservoirs

For the case of a water drive reservoir, the withdrawal of oil and gas results in a reservoir pressure drop which permits water to enter into the reservoir. The water tends to sustain the pressure and displaces oil ahead of it. The degree to which water enters the reservoir and reservoir pressure is maintained depends upon the availability of water, the ease with which the water can move into the reservoir or the permeability of the reservoir, the rate at which oil and gas is being withdrawn, and the conservation of water. By conservation of water is meant the degree to which its production is minimized. In a water drive reservoir, pressures are usually maintained at a fairly high level (Figure 2), gas-oil ratios are usually maintained at a low value (Figure 3), and large quantities of water are produced as upstructure wells are passed successively by the water front. Recovery from a water drive reservoir is usually very high and may reach as much as 80 percent of oil originally in place, provided water moves through all segments of the reservoir sand and all areas over which the reservoir occurs.

Two types of calculations are employed in the study of water drive reservoirs. First is the study of the volumetric behavior, and the second is the study of the displacement efficiency. The volumetric behavior is determined by simultaneous solution of volumetric balance, a classic form of which was published by Schilthuis,[3] and some radial flow or unsteady state water influx equation. The volumetric balance in this case balances produced oil, gas and water, as materials withdrawn, with expansion of the remaining oil and gas in the reservoir together with the water that entered the reservoir from the water basin, as the materials taking the place of the withdrawals. Figure 5 illustrates this volumetric balance relation.

Of the various radial flow methods[4, 5, 6] in use, perhaps the one used most widely was published by Hurst.[4] Figure 6 illustrates the location and direction of movement of water from which the radial flow mechanics were conceived. The purpose of the simultaneous calculation is to determine on a firm basis the amount of water that has entered the reservoir and replaced oil. When this influx is satisfactorily determined by both equations for past behavior of the reservoir, the equations are considered applicable for use in predictions of future reservoir behavior. The results of the volumetric behavior computations involve behavior in terms of fluid volumes and no geometry is involved. That is, these calculations do not tell the analyst where the fluid movements are taking place. This latter information is usually needed however to answer many operational questions and is obtained from the displacement studies.

Displacement efficiency calculations which permit determination of the all important item, recovery of oil under various modes of operations, can then be made by means of the displacement equations of Buckley and Leverett.[7] Figure 7 illustrates schematically the mechanism of displacement of oil by water encroachment. These calculations, of course, must be made in conjunction with studies dealing with geometry, continuity, and degree of homogeneity of the particular reservoir under study.

The displacement calculations permit the determination of the water saturation and the remaining oil saturation at different points in the reservoir from the original oil-water contact after each period of time as the water moves into the reservoir. With saturations thus determined and the amount of water that entered the reservoir determined by the volumetric balance and unsteady state water influx equations the distance the oil-water contact has moved upstructure is then determined on a volumetric basis. Schematic diagrams are used to obtain fluid inventories for each production period in the life of the reservoir. Figure 7 represents the inventory of the reservoir fluids for the first two production periods. Of particular interest in this illustration is the quantity of oil remaining behind the displacing water. This volume is in inverse proportion to the quantity of oil displaced by the water. By repeating displacement calculations with various assumed reservoir producing rates and ratios, the operating conditions which result in optimum oil recovery can be determined.

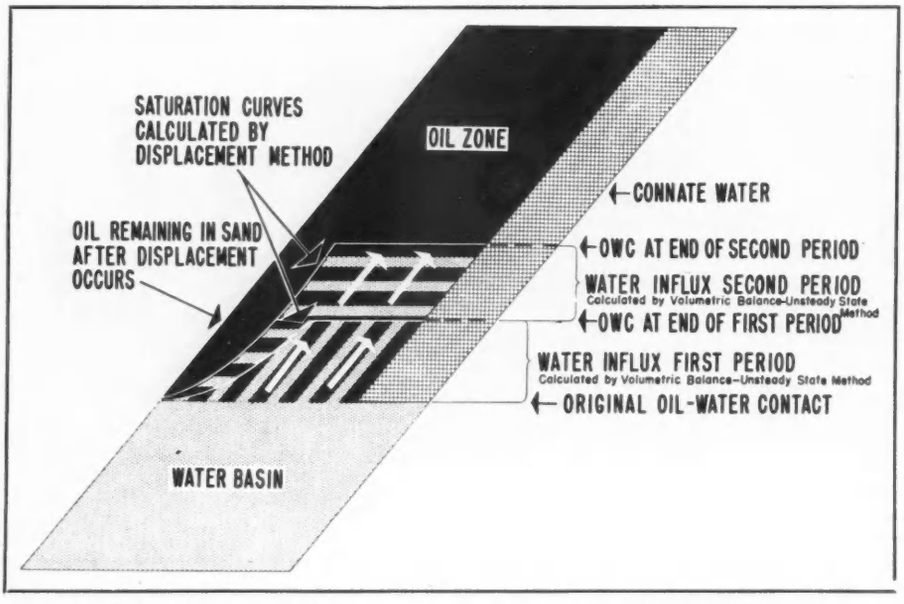
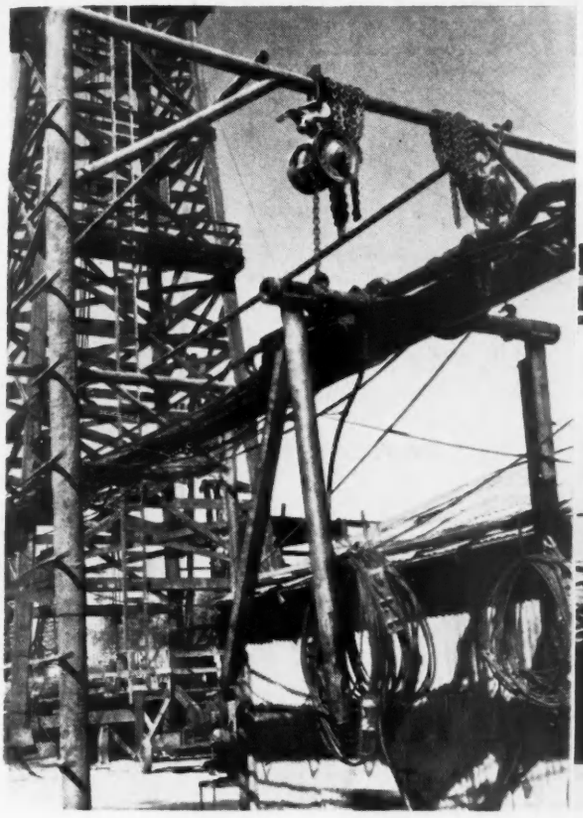
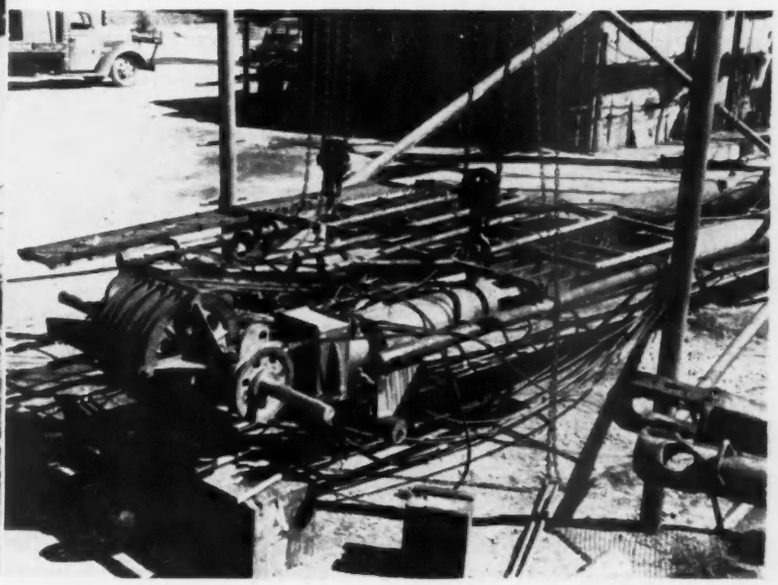

SATURATION CURVES CALCULATED BY DISPLACEMENT METHOD
OIL ZONE
CONNATE WATER
OIL REMAINING IN SAND AFTER DISPLACEMENT OCCURS
OWC AT END OF SECOND PERIOD
WATER INFLUX SECOND PERIOD
Calculated by Volumetric Balance-Unsteady State Method
OWC AT END OF FIRST PERIOD
WATER INFLUX FIRST PERIOD
Calculated by Volumetric Balance-Unsteady State Method
ORIGINAL OIL-WATER CONTACT
WATER BASIN

FIGURE 7. Displacement of oil by water illustrating method of calculating recover.



**LEFT. Single mast unit suspended by chain blocks in position to be lowered into place on servicing truck. Paired blocks allow mast to be elevated by two men without power aid, while their retention in place permits prompt placing of masts in service when needed.**

**BELOW. Showing the lifting bands and eyes affixed to both legs of dual mast, to insure straight lifting of mast and prevent jamming of equipment on mast. Photograph shows mast lowered to permit maintenance work on crown block assembly.**



# Servicing Mast Storage Racks

WHEN well service units are employed for different types of surface equipment, wells with and without derricks, the pulling machine is more maneuverable when the folding mast is removed in servicing a well where a standard derrick is provided. The problem of removing, storing and replacing the mast, whether it is a single or double post type, has been satisfactorily solved by a company in Long Beach, Calif.

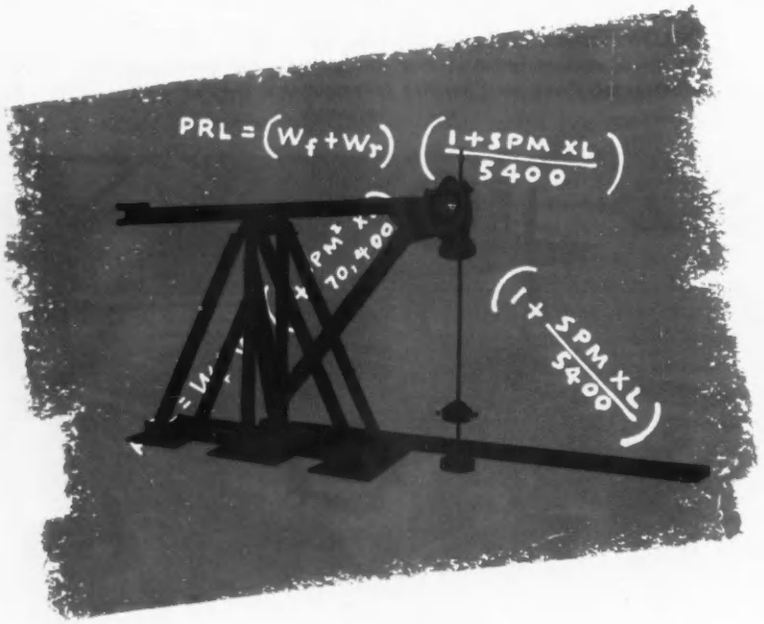
These mast handling structures are installed as near the company shops as practicable so the equipment may be serviced, repaired and inspected where tools are available for this type of work. Two types of masts are used, one having a single post for light service, such as a simple rod job, and the other with a double mast when used on long strings of heavy tubing. Both structures are built with four corner posts high enough that the masts may be lifted from the pulling machine trucks for storing after being disconnected. Footing for the corner posts is made by welding large rectangular sheets of heavy steel to the lower end so as to support the load imposed upon the structure without sagging or distortion. Gusset plates are welded to the foot of the corner posts and to the bearing pad to reinforce this welded connection.

### Reinforcing Struts

Each pair of corner posts has a horizontal cross member supported at the top of each post and reinforced with diagonal struts so as to supply an adequate beam to which the hoisting equipment is connected. Diagonal braces connect each pair of corner posts to produce sufficient stiffness of the structure to support the weight of the masts and auxiliary equipment. D links are placed on the horizontal bars into which the hooks of the chain blocks can be inserted or removed without disturbing the arrangement of the equipment.

The posts of the masts are fitted with substantial rings where links are attached for hooking the lower part of the chain block without improvising an anchor each time the mast is removed from the pulling machine truck. When either type of pulling machine mast requires repairs, inspection or lubrication, the units can be lowered to ground level so any type of maintenance can be carried on without difficulty. If, for example, the crown block requires extensive repairs, the welders and other mechanics can service the equipment by lowering to supporting cribbing where tools can be employed to greatest advantage.

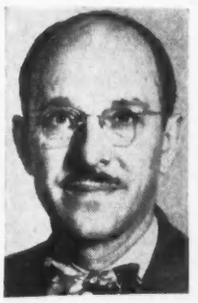
# Simplified Pumping Well Calculations




By A. A. HARDY

Chief Engineer

W. C. Norris, Manufacturer, Inc., Tulsa



**CALCULATIONS for a pumping well can become so complicated that the possibility of error is apt to introduce erroneous conclusions, especially when combined with the many assumptions which must be made due to inability of actual value determinations. The author combines two of the well-known formulas within their ranges where most closely borne out by dynamometer tests, and develops tables and charts which will enable a well to be figured quickly and with the range of variations not only defined but also kept to minimum values.**

THERE is a wealth of information giving formulas for calculating polished rod loads, rod stretch, tubing stretch, plunger over-travel, production in barrels per day, harmonic or synchronous pumping speeds, design of tapered strings and the like. However, there is no one source to which one may go for all of this information without having to wade through a tremendous amount of unrelated data. Several slide rules have been devised from which most of it can be secured in varying degrees of accuracy, but the writer feels that unless the rule is used constantly, it becomes almost as big a job, each time it is used, to determine the proper sequence of operation of the various scales and slides as it would have been to make the calculations long hand in the first place.

It is the purpose of this paper to assemble the various formulas "under one roof" and present them by means of tables and charts in such a manner and form that they will be readily available and will be so devised that a "refresher course" will not be needed before using them, even though appreciable intervals of time elapse.

**TABLE 1**
**Combined Fluid and Sucker Rod Weight**

| Diameter Pump Plunger In Inches | 5/8" Rods | 3/4" Rods | 7/8" Rods | 1" Rods |
|---|---|---|---|---|
| 7/8" | 1.42 | 1.89 | 2.42 | 3.14 |
| 1" | 1.50 | 1.97 | 2.50 | 3.22 |
| 1 1/16" | 1.54 | 2.01 | 2.54 | 3.26 |
| 1 1/4" | 1.69 | 2.16 | 2.69 | 3.41 |
| 1 5/16" | 1.86 | 2.33 | 2.86 | 3.58 |
| 1 1/2" | 1.93 | 2.40 | 2.93 | 3.65 |
| 1 3/4" | 2.20 | 2.67 | 3.20 | 3.92 |
| 1 25/32" | 2.24 | 2.71 | 3.24 | 3.96 |
| 1 15/16" | 2.44 | 2.91 | 3.44 | 4.16 |
| 2" | 2.52 | 2.99 | 3.52 | 4.24 |
| 2 1/4" | 2.88 | 3.35 | 3.88 | 4.60 |
| 2 1/2" | 3.29 | 3.76 | 4.29 | 5.01 |
| 2 3/4" | 3.73 | 4.20 | 4.73 | 5.45 |
| 3 1/4" | 4.75 | 5.22 | 5.75 | 6.47 |
| 3 3/4" | 5.94 | 6.41 | 6.94 | 7.66 |
| 4 1/4" | 7.30 | 7.77 | 8.30 | 9.02 |
| 4 3/4" | 8.83 | 9.30 | 9.83 | 10.55 |

All formulas of this nature are necessarily based on certain broad assumptions with many variable factors ignored. For instance, in all cases the fluid level is assumed to be at the pump, and the influence of gas has been disregarded. Consequently, the results obtained from their use are not to be taken as absolute criteria, because variables are too numerous and unpredictable. The value of these calculations lies in obtaining information needed for design of pumping equipment or proper operation of the equipment where actual loads and characteristics are not known.

### Maximum Polished Rod Loads

There is a definite need for a simple and uniform means of estimating polished rod loads where dynamometer cards or other accurate means are not available. These means, naturally, should be as accurate as possible and should conform as closely as possible to actual experience. Here, especially, it must be remembered that any means of calculating well loads is an estimate only and can never be relied upon as accurate, due to the many unknowns involved. These unknowns include such items as friction, which varies with straightness of the hole, paraffin accumulations, fluid level, specific gravity, gas conditions, bottom-hole pump efficiency, and other undeterminables.

An intensive study of a great many dynamometer cards should presumably develop a formula which could duplicate *average* polished rod loads somewhat more accurately than the formulas we now use, but this somewhat greater accuracy would be of such small order when compared to the range of inaccuracy that is inherent in such calculations that such a

project would be of little practical value. There are two formulas which have been extensively used for this purpose. The best known was proposed by Slonneger:

$$PRL = (W_f + W_r)\left(1 + \frac{SPM \times L}{5400}\right)$$

Where $W_f$ = Weight of fluid
$W_r$ = Weight of rods
SPM = Strokes per minute
L = Length of stroke in inches

Here the weight of the fluid is based on the gross area of the pump and a specific gravity of 1 is usually used. Buoyancy of the rods is assumed in figuring rod weight to approximately offset friction. This is the simplest of the two formulas because the combined weight of the rods and fluid, which can be easily tabulated (see Table 1), is multiplied by the impulse factor:

$$\left(1 + \frac{SPM \times L}{5400}\right)$$

which also can be easily tabulated. (See Table 2.) This formula is presented as a recommended method of estimating well loads in API Standard No. 11-E.

The second formula, known as the Mills formula,[1] follows:

$$PRL = W_f - W_r\left(1 + \frac{SPM^2 \times L}{70{,}400}\right)$$

Here again the weight of the fluid is based on the gross area of the pump and buoyancy of the rods is neglected. The impulse factor is larger, and is applied only to the weight of the rods and not to the weight of the fluid. As a consequence, separate calculations must be made on the weight of the rods and fluid, and the formula is not quite as simple to apply as the Slonneger formula.

The first formula has been recog-

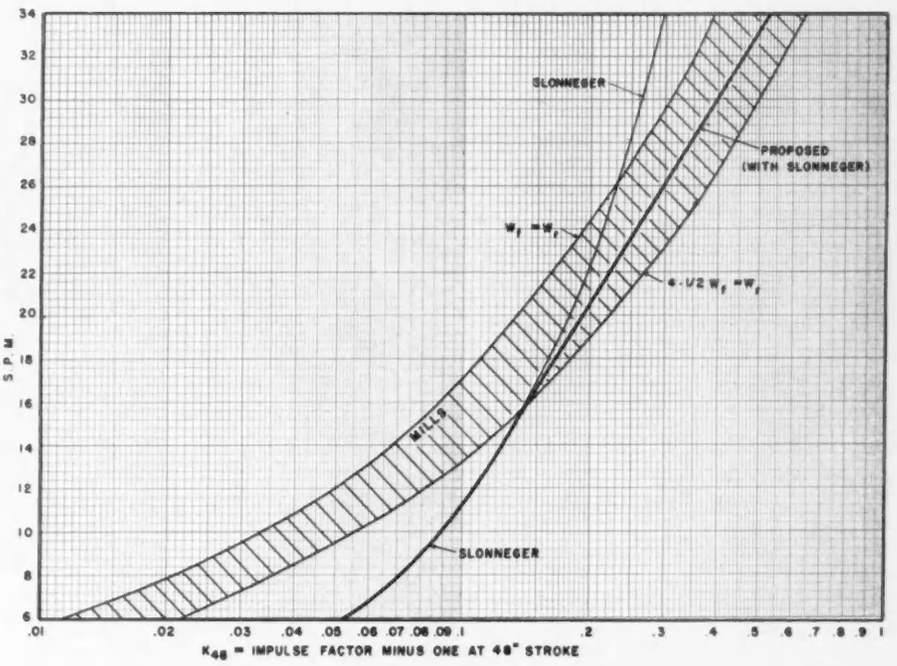



FIGURE 1

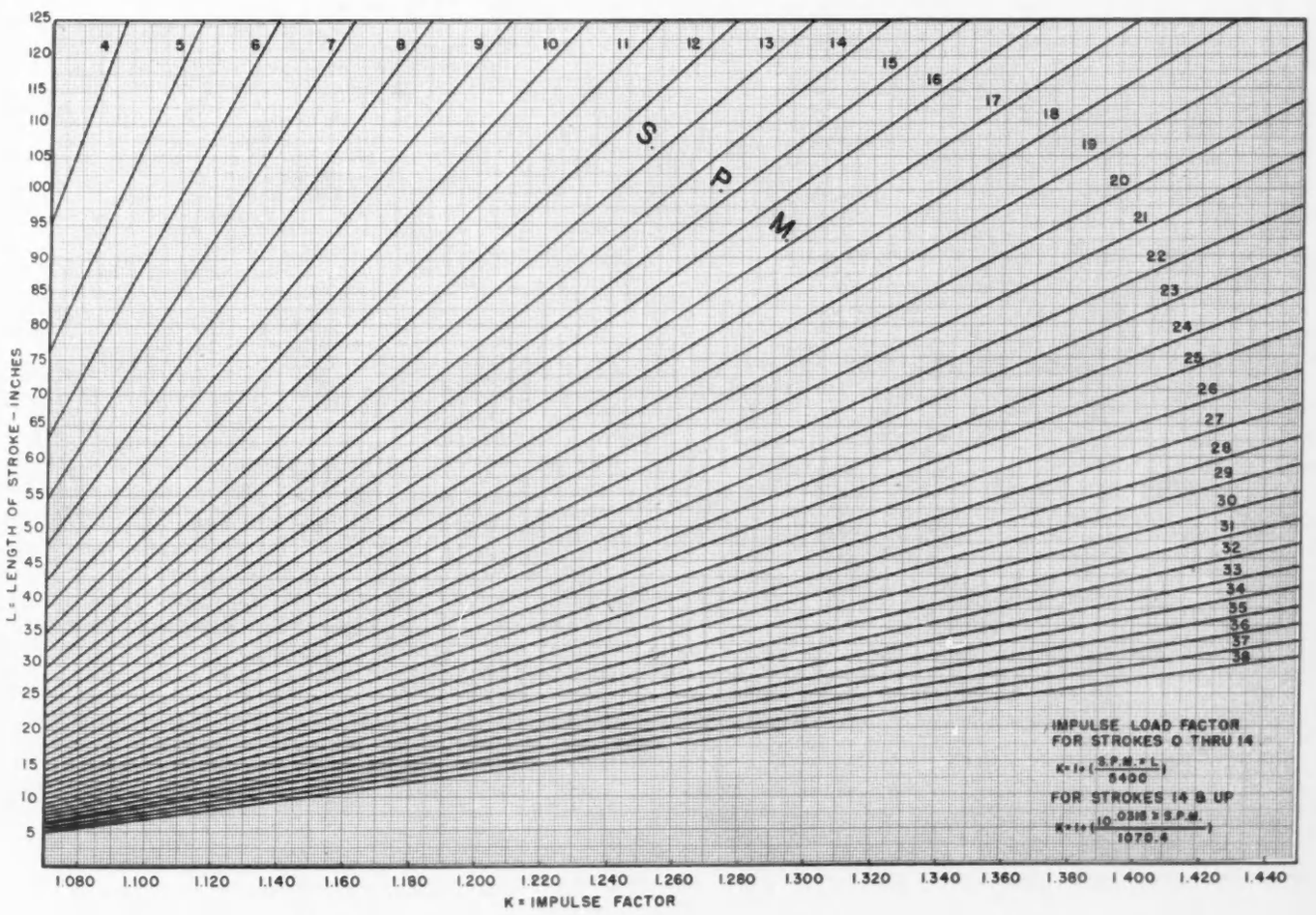

S.P.M.
L = LENGTH OF STROKE - INCHES
K = IMPULSE FACTOR
IMPULSE LOAD FACTOR
FOR STROKES 0 THRU 14
$K = 1 + \left(\frac{S.P.M. \times L}{5400}\right)$
FOR STROKES 14 & UP
$K = 1 + \left(\frac{10^{.0318 \times S.P.M.}}{1070.6}\right)$

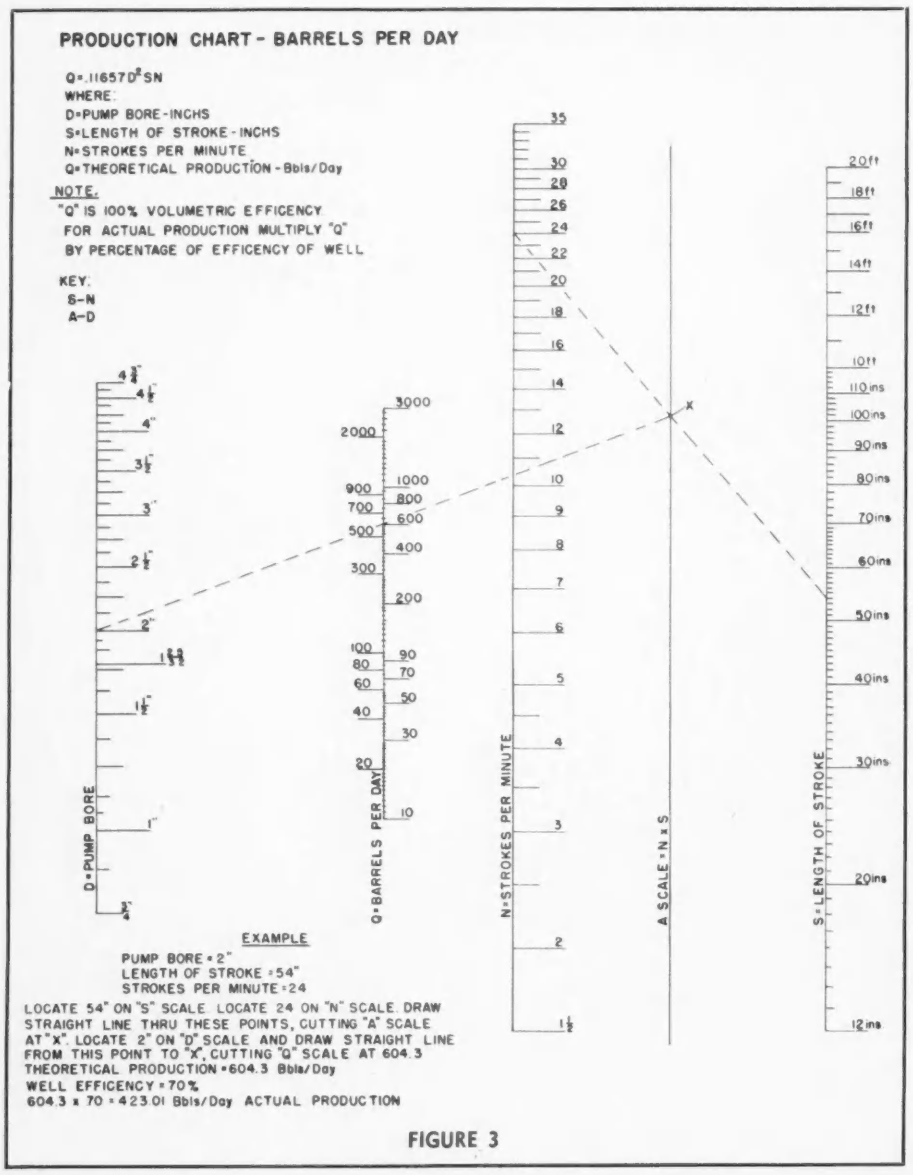
FIGURE 2

nized for some time as being more accurate at pumping speeds below 18 or 20 strokes per minute.[2] Above this speed, however, the results given by it are usually low. Above 20 strokes per minute, experience has indicated that the Mills formula gives results more closely approximating actual experience. However, due to the manner in which the impulse factor is applied, the results depend on the relative weight of the rods and the fluid. Where the weight of the rods and fluid are about equal, this formula gives results that are apt to be low, being lower, in fact, than the Slonneger formula results up to about 26 strokes per minute. This condition, of course, occurs in shallower wells where relatively large pumps and small rods are used and where the higher speeds are apt to be used. To get the most accurate results then, a person estimating well loads must jump from one formula to the other, depending on the speed at which the well is to be operated, also keeping in mind the effect of the relative weight of the rods and fluid at the higher speeds.

**TABLE 2**
**Impulse Load Factor**

| Stroke Length Inches | STROKES PER MINUTE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
| 18 | 1.034 | 1.040 | 1.048 | 1.054 | 1.062 | 1.072 | 1.083 | 1.096 | 1.111 | 1.129 | 1.149 | 1.170 |
| 24 | 1.045 | 1.054 | 1.063 | 1.072 | 1.083 | 1.095 | 1.111 | 1.128 | 1.148 | 1.171 | 1.198 | 1.226 |
| 28 | 1.053 | 1.062 | 1.073 | 1.084 | 1.097 | 1.111 | 1.129 | 1.150 | 1.173 | 1.200 | 1.231 | 1.264 |
| 30 | 1.056 | 1.067 | 1.078 | 1.090 | 1.103 | 1.119 | 1.138 | 1.160 | 1.185 | 1.214 | 1.247 | 1.283 |
| 34 | 1.064 | 1.076 | 1.089 | 1.102 | 1.117 | 1.135 | 1.156 | 1.182 | 1.210 | 1.242 | 1.281 | 1.320 |
| 38 | 1.071 | 1.085 | 1.099 | 1.113 | 1.131 | 1.151 | 1.175 | 1.202 | 1.234 | 1.271 | 1.313 | 1.357 |
| 44 | 1.082 | 1.098 | 1.115 | 1.131 | 1.151 | 1.175 | 1.202 | 1.235 | 1.271 | 1.313 | 1.363 | 1.419 |
| 48 | 1.090 | 1.107 | 1.125 | 1.143 | 1.165 | 1.191 | 1.221 | 1.256 | 1.296 | 1.342 | 1.395 | 1.457 |
| 54 | 1.100 | 1.120 | 1.140 | 1.161 | 1.185 | 1.215 | 1.248 | 1.288 | 1.333 | 1.384 | 1.445 | 1.514 |
| 60 | 1.111 | 1.133 | 1.156 | 1.179 | 1.206 | 1.238 | 1.276 | 1.320 | 1.370 | 1.427 | 1.494 | .... |
| 64 | 1.119 | 1.142 | 1.166 | 1.190 | 1.220 | 1.254 | 1.294 | 1.341 | 1.394 | 1.456 | .... | .... |
| 72 | 1.134 | 1.160 | 1.187 | 1.214 | 1.247 | 1.286 | 1.331 | 1.383 | 1.443 | .... | .... | .... |
| 74 | 1.137 | 1.164 | 1.192 | 1.220 | 1.254 | 1.294 | 1.340 | 1.394 | 1.456 | .... | .... | .... |

A need was seen, therefore, for a formula which would blend smoothly into the Slonneger values below 20 strokes per minute and which would give average Mills values at speeds higher than this. It was also desirable to have the impulse factor applied to the combined weight of the rods and fluid for purposes of simplicity. In order to accomplish this, the Slonneger formula impulse factor, minus one for readability, was plotted on semi-logarithmic paper. Then an impulse factor was plotted which would give results equivalent to the Mills results where the weight of the rods equaled the weight of the fluid and also another where the weight of the rods was four and one-half times the weight of the fluid. This resulted in an equivalent average band of Mills formula impulse factor values comparable to the Slonneger values. Inasmuch as both impulse factors vary directly with the stroke length and in the same degree, all calculations were made and plotted using a stroke of 48 inches. This curve is shown as Figure 1. An inspection of the results indicated that a sloping straight line tangent to the Slonneger curve at 14 spm and giving an average Mills factor value of .530 at 34 spm would be the desired curve.


PRODUCTION CHART - BARRELS PER DAY
Q=.11657D²SN
WHERE:
D=PUMP BORE-INCHS
S=LENGTH OF STROKE-INCHS
N=STROKES PER MINUTE
Q=THEORETICAL PRODUCTION-Bbls/Day
NOTE:
"Q" IS 100% VOLUMETRIC EFFICENCY
FOR ACTUAL PRODUCTION MULTIPLY "Q"
BY PERCENTAGE OF EFFICENCY OF WELL
KEY:
S-N
A-D
D=PUMP BORE
Q=BARRELS PER DAY
N=STROKES PER MINUTE
A SCALE=N x S
S=LENGTH OF STROKE
EXAMPLE
PUMP BORE=2"
LENGTH OF STROKE=54"
STROKES PER MINUTE=24
LOCATE 54" ON "S" SCALE LOCATE 24 ON "N" SCALE DRAW STRAIGHT LINE THRU THESE POINTS, CUTTING "A" SCALE AT "X". LOCATE 2" ON "D" SCALE AND DRAW STRAIGHT LINE FROM THIS POINT TO "X", CUTTING "Q" SCALE AT 604.3
THEORETICAL PRODUCTION=604.3 Bbls/Day
WELL EFFICENCY=70%
604.3 x 70 = 423.01 Bbls/Day ACTUAL PRODUCTION
FIGURE 3

The formula for a straight line on semi-logarithmic paper takes the empirical form:

$$y = 10^{(a+bx)} \qquad (1)$$

then the formula was found by substituting the two known sets of values in the above formula and solving simultaneously as follows:

$$K_{48} = 10^{(a+bs)} \qquad (2)$$

Where $K_{48}$ = Impulse factor minus one at 48-inch stroke length
s = Strokes per minute

taking logarithms:

$$\log K_{48} = a + bs \qquad (3)$$

At 14 spm and a 48-inch stroke, the Slonneger factor minus one equals 0.124. An inspection of the curve indicates that $K_{48}$ at 34 spm for an average Mills factor value would be .530. Tabulating gives:

| S | K | log K |
|---|---|---|
| 14 | .124 | 9.093422 — 10 |
| 34 | .530 | 9.724276 — 10 |

substituting in (3) and solving simultaneously,

$$9.724276 - 10 = a + 34b$$
$$9.093422 - 10 = a + 14b$$
$$.630854 = 20b$$
$$b = .0315427$$
$$9.724276 - 10 = a + .0315427 \times 34$$
$$a = -1.348176$$

therefore, substituting in (2)

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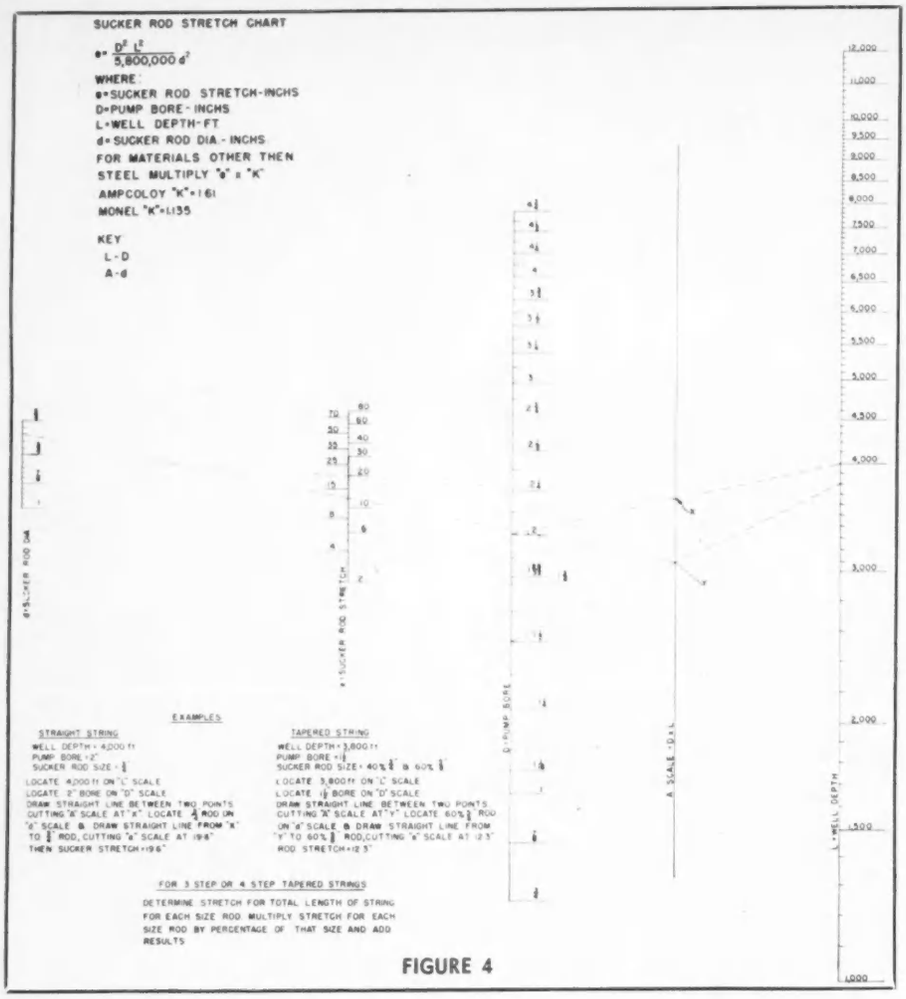


FIGURE 4

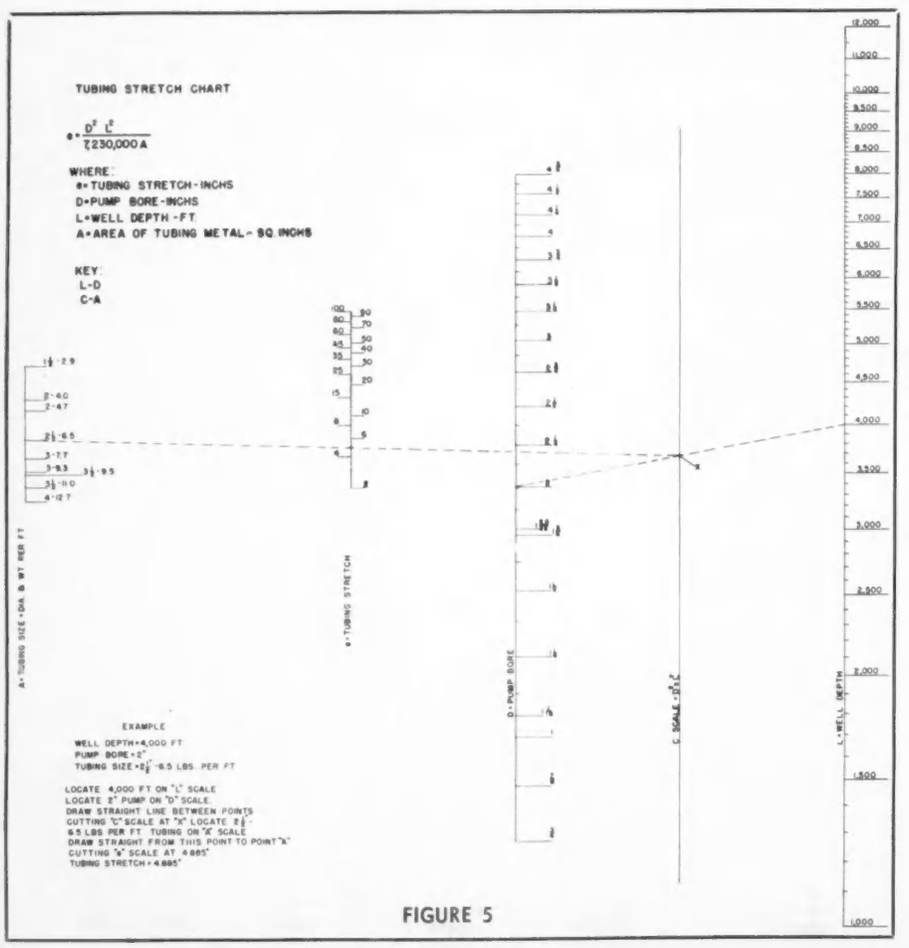
TUBING STRETCH CHART
WHERE:
e = TUBING STRETCH-INCHS
D = PUMP BORE-INCHS
L = WELL DEPTH-FT
A = AREA OF TUBING METAL-SQ INCHS
KEY:
L-D
C-A
EXAMPLE
WELL DEPTH = 4,000 FT
PUMP BORE = 2"
TUBING SIZE = 2⅜" - 6.5 LBS. PER FT
LOCATE 4,000 FT ON "L" SCALE
LOCATE 2" PUMP ON "D" SCALE
DRAW STRAIGHT LINE BETWEEN POINTS
CUTTING "C" SCALE AT "x" LOCATE 2⅜" -
6.5 LBS PER FT TUBING ON "A" SCALE
DRAW STRAIGHT FROM THIS POINT TO POINT "x"
CUTTING "e" SCALE AT 4.885"
TUBING STRETCH = 4.885"

FIGURE 5

$$K_{48} = \frac{10^{-1.348 + .0315s}}{22.3} = \frac{10^{.0315s}}{22.3} \text{ (at 48-inch stroke)}$$

for any stroke then

$$K = \frac{10^{.0315s} \times L}{1070.4}$$

At first glance this appears somewhat complicated, although with a table of logarithms handy look up the anti-log of .0315 times the strokes per minute and multiply it by the stroke length and divide the result by 1070.4 to get K. However, inasmuch as this factor applies to the combined weight of the fluid and the rods, it can be tabulated as in Table 2 over the applicable range, together with the Slonneger factors below 16 strokes per minute, which, together with Table 1, the combined fluid and rod weights, presents a much simplified means of estimating well loads over the entire range. The results will average the same as if the two separate formulas were used, each within its proper range, and will be more accurate than either under extreme conditions of fluid weight to rod weight ratios at speeds above 20 spm. Figure 2 is a graph of the impulse factors, which illustrates the regularity of their spacing and permits direct reading of fac-

**TABLE 3**

**Correct Length of Component Parts of Tapered Strings**

| ¾"—⅝" Combination | | ⅞"—¾" Combination | | 1"—⅞" Combination | |
|---|---|---|---|---|---|
| Plunger Dia. | Percent of ⅝" Needed | Plunger Dia. | Percent of ⅞" Needed | Plunger Dia. | Percent of 1" Needed |
| ⅞" | 30.0 | ⅞" | 25.5 | ⅞" | 21.5 |
| 1" | 31.6 | 1" | 26.6 | 1" | 22.2 |
| 1 1/16" | 32.5 | 1 1/16" | 27.2 | 1 1/16" | 22.6 |
| 1 ¼" | 35.6 | 1 ¼" | 29.2 | 1 ¼" | 23.9 |
| 1 7/16" | 39.2 | 1 7/16" | 31.4 | 1 7/16" | 25.4 |
| 1 ½" | 40.7 | 1 ½" | 32.4 | 1 ½" | 26.1 |
| 1 ¾" | 46.4 | 1 ¾" | 36.1 | 1 ¾" | 28.5 |
| 1 25/32" | 47.3 | 1 25/32" | 36.6 | 1 25/32" | 28.8 |
| 1 15/16" | 51.5 | 1 15/16" | 39.3 | 1 15/16" | 30.6 |
| 2" | 53.2 | 2" | 40.4 | 2" | 31.3 |
| 2 ¼" | 60.8 | 2 ¼" | 45.2 | 2 ¼" | 34.6 |
| 2 ½" | 69.5 | 2 ½" | 50.8 | 2 ½" | 38.2 |
| 2 ¾" | 78.7 | 2 ¾" | 56.7 | 2 ¾" | 42.1 |
| 3 ¼" | 100.0 | 3 ¼" | 70.5 | 3 ¼" | 51.2 |
| ..... | ..... | 3 ¾" | 86.6 | 3 ¾" | 61.7 |
| ..... | ..... | ..... | ..... | 4 ¼" | 73.9 |
| ..... | ..... | ..... | ..... | 4 ¾" | 87.5 |

**TABLE 4**

**Correct Length of Component Parts of 3-Way Tapered Strings**

| | 1"—⅞"—¾" Combination | | ⅞"—¾"—⅝" Combination | |
|---|---|---|---|---|
| Plunger Diameter | Percent of 1" Needed | Percent of ⅞" Needed | Percent of ⅞" Needed | Percent of ¾" Needed |
| ⅞" | 18.8 | 21.5 | 22.0 | 24.7 |
| 1" | 19.6 | 22.4 | 23.2 | 26.1 |
| 1 1/16" | 20.0 | 22.8 | 23.8 | 26.8 |
| 1 ¼" | 21.5 | 24.5 | 26.2 | 29.4 |
| 1 7/16" | 23.1 | 26.5 | 28.8 | 32.3 |
| 1 ½" | 23.8 | 27.3 | 30.0 | 33.6 |
| 1 ¾" | 26.5 | 30.3 | 34.1 | 38.2 |
| 1 25/32" | 26.9 | 30.8 | 34.7 | 38.9 |
| 1 15/16" | 28.9 | 33.0 | 37.8 | 42.4 |
| 2" | 29.7 | 34.0 | 39.0 | 43.8 |
| 2 ¼" | 33.3 | 38.0 | 44.6 | 50.1 |
| 2 ½" | 37.4 | 42.7 | 51.0 | 49.0 |
| 2 ¾" | 41.7 | 47.6 | 57.8 | 42.2 |

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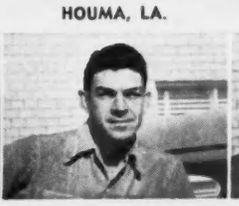
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# GAS LIFT

tors not given in the table, thus eliminating the necessity of interpolating.

As an example, the calculations for a well with seven-eighth-inch rods, 4500 feet deep, a 1 25/32-inch pump being stroked with twenty-six 54-inch strokes per minute would be (using tables):

Proposed:

$4500 \times 3.24 \times 1.333 = 19{,}435$ lbs. P.R.L.

Slonneger:

$4500 \times 3.24 \times 1.260 = 18{,}371$ lbs. P.R.L.

Mills:

$$.34 \times 1\text{-}25/32^2 \times 4500 + 2.16 \times 4500 \left(1 + \frac{26^2 \times 54}{70{,}400}\right) = 19{,}615$$

Further illustrating the difference in the results of the three formulas, take the following two additional wells:

| | Rods | SPM | Pump Bore | Stroke Length |
|---|---|---|---|---|
| Well No. 2.... | 4000' of 7/8" | 28 | 1 15/16" | 54" |
| Well No. 3.... | 1675' of 1"<br>3725' of 7/8" | 16 | 2" | 64" |

Then tabulating the results:

| | Slonneger | Mills | Proposed |
|---|---|---|---|
| Well No. 1..... | 18,371lb | 19,615lb | 19,435lb |
| Well No. 2..... | 17,613lb | 18,948lb | 19,044lb |
| Well No. 3..... | 24,055lb | 23,220lb | 24,055lb |

It should be clearly realized and understood that this proposed method of figuring polished rod loads is not a new formula. It is simply a method of combining two existing and well recognized formulas for some simple and more accurate use.

### Design of Tapered Strings

The objective in designing a tapered string is to so proportion the lengths of the rod sizes involved so that the stress imposed by rod weight and fluid weight will be the same in the top rod of each size involved. Formulas for this purpose were very completely developed by Kemler.[3] Table 3 gives the correct percentage based on this premise of the larger rod needed in two-way tapers for 5/8-, 3/4-, 7/8- and 1-inch rods. Table 4 gives the correct percentages of the two larger rods in a three-way taper string. For any particular combination of rod sizes and the plunger diameter, the length of the rod string is multiplied by the indicated percentages and the correct length of each thus determined. For instance, a 5000-foot well, using a 7/8-, 3/4-, 5/8-inch combination with a 1 1/4-inch pump, requires 26.2 percent of 7/8-inch, 29.4 percent of 3/4-inch, and 44.4 percent of 5/8-inch rods. Working this out to the nearest 25-foot lengths needs 1300 feet of 7/8-inch, 1475 feet of 3/4-inch, and 2225 feet of 5/8-inch rods.

Table 5 gives the average weight per foot of the fluid and sucker rods combined for all tapered rod combinations. These figures are based on the correct respective lengths for tapered strings as given in Tables 3 and 4 and permit calculation of the maximum polished rod load without first figuring the proper lengths of each section and the figuring of each as a separate well. This table also permits a much more rapid selection of the proper rod size combination for any particular depth and pump diameter.

### Production in Barrels Per Day

Figure 3 is an alignment chart permitting rapid calculation of production in barrels per day based on length of stroke, strokes per minute, and pump bore. The formula is given on the chart and is based on 100 percent efficiency of the pump. This chart is particularly handy, for it may be entered on any scale and the variation in the other factors quickly observed. For instance, with a two-inch pump and 600 barrels per day required, the variation between length of stroke and strokes per minute is readily apparent. In the case illustrated, this would require twenty-four 54-inch strokes per minute, or swinging a straight edge around point "X" shows that eighteen 72-inch strokes per minute would give the same results.

### Net Plunger Stroke

The net plunger stroke is influenced by three main considerations—rod stretch, tubing stretch, and plunger over-travel. These factors become important particularly in deep wells where they strongly influence the selection of the proper size pump for maximum production and minimum loads.

Rod and tubing stretch occur un-

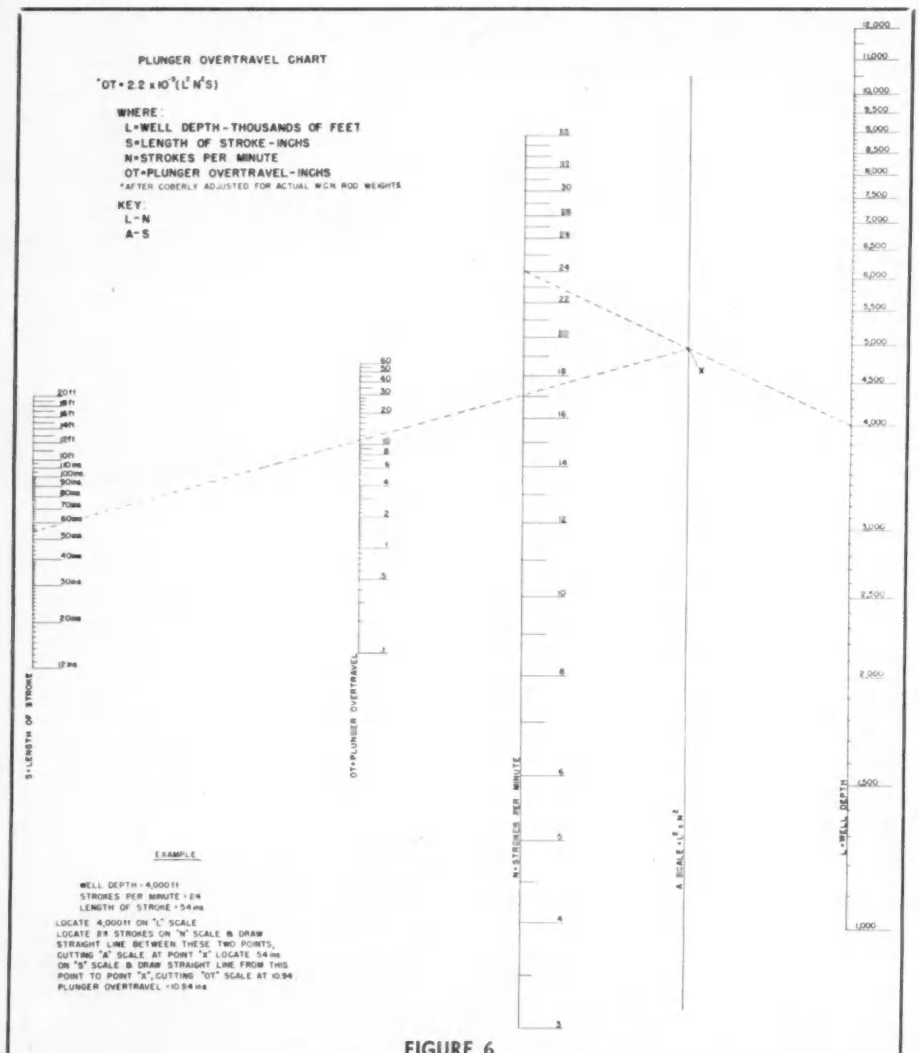


FIGURE 6

# It doesn't have to be this way...

WHAT'S THAT? A DUST STORM COMING UP?
NAW, IT'S JUST OCEANOIL'S PUMPERS HIGH TAILIN' IN TO REPORT WELLS OFF
HAPPENS EVERY A.M. YOU'LL GET USED TO IT
It can be like this !
SURE HAS BEEN QUIET OVER AT OCEANOIL LATELY
WHAT HAPPENED? ALL THEIR WELLS SUDDENLY START FLOWIN' AGAIN?
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der the following conditions. As the plunger starts on the up-stroke, the traveling valve closes, thus causing the sucker rods to assume the full weight of the fluid column. Being elastic, they will stretch in response to this load and will consequently reduce the plunger stroke with respect to the polished rod's stroke by the amount of this stretch. At the same instant the tubing, which had been carrying the load of the fluid column, now being relieved of this load relaxes and shortens, elastically, following the plunger upward until entirely relieved of the load, thus also shortening the effective plunger stroke. This sucker rod and tubing stretch is given in Figures 4 and 5. It is worth noting that we do not take into account the stretch due to the rod and tubing dead weight, which is constant on both the up and down stroke: rather only the superimposed load of the fluid column which is transferred from one to the other is considered. Both charts are based, therefore, on the pump diameter and depth of the well, together with the area of the metal involved and the modulus of elasticity of steel. As mentioned above, they must both be deducted from the polished rod stroke.

Plunger over-travel is caused by the dynamic effect or momentum of the rods and the load they are carrying. At the top of the stroke, due to momentum and the elasticity of the system, the plunger tends to continue upward after the polished rod starts downward. Likewise, at the bottom of the stroke it tends to continue downward after the polished rod starts back upward. Consequently, plunger over-travel offsets rod and tubing stretch and may, under certain conditions of high speeds, even increase the plunger's stroke beyond the polished rod's stroke. This phenomenon is so tied up with harmonics, friction, viscosity, and other indeterminants that it is the least susceptible to definite analysis of the three. However, the formula usually used was developed by Coberly[4] and is illustrated in Figure 6 and arranged as a nomograph for easy solution.

Summarizing, to figure net plunger stroke add plunger over-travel taken from Figure 6 to polished rod stroke and deduct rod and tubing stretch as given in Charts 4 and 5. If the tubing is anchored at the pump, tubing stretch should be eliminated from the calculations. As an example of the use of these three factors, Table 6 is presented. The value of such an analysis becomes quite apparent when selecting pump sizes for the deeper wells. The calculations involved are greatly simplified by the use of these alignment charts.

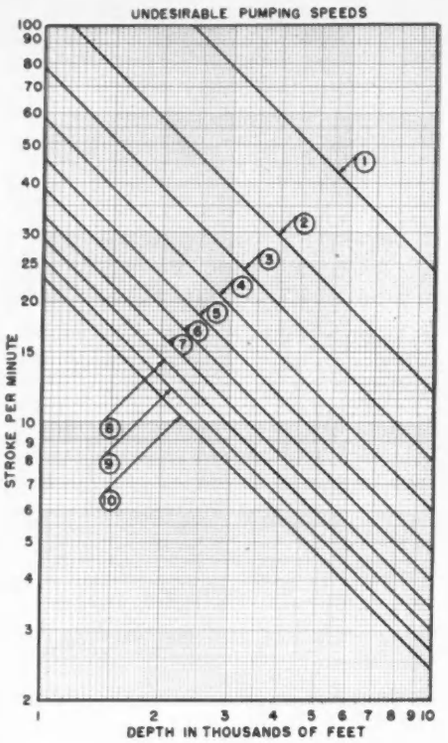


FIGURE 7

## Synchronous or Undesirable Pumping Speeds

J. C. Slonneger has developed a formula for synchronous pumping speeds.[5] All are familiar with machinery which, when reaching some particular speed, will vibrate and rattle as though it might fly to pieces. If this particular speed is exceeded or reduced, it smooths out with no troublesome vibration. The same conditions can exist in sucker rods where, on a harmful harmonic speed, the synchronous vibrations evidence themselves, not particularly in noise, but in high stresses above those included in normal calculations. They are usually accompanied by excessive plunger over-travel. Abnormally high pumping volumetric efficiencies might indicate this condition. Figure 7 gives the speeds to be avoided for any particular depth. Line 1 represents the first order harmonic, which could be quite dangerous. It is placed so high on the chart, however, that it is never encountered. The second order harmonic could be quite troublesome. It is used in cable tool drilling to give maximum impact to the bit. The third order harmonic could be serious, the fourth is of small importance, and the others of no practical significance.

It is noteworthy that the position of the curve varies only with the speed and length of the string and not the size of the rod. Density and not weight enters into the formula; consequently, size or diameter is not a consideration. Tapered strings would theoretically affect the results, but the error so introduced is well within the application error and can be neglected. The position of the curves will vary, however, with a change in density and modulus of elasticity; hence, new charts must be drawn for sucker rod materials other than steel.

**TABLE 5**

**Average Weight Per Foot, Combined Fluid and Sucker Rods, for Tapered Strings**

| Plunger Diameter | 1"—7/8" —3/4" | 7/8"—3/4" —5/8" | 3/4"—5/8" | 7/8"—3/4" | 1"—7/8" |
|---|---|---|---|---|---|
| 7/8" | 2.24 | 1.76 | 1.56 | 2.03 | 2.58 |
| 1" | 2.33 | 1.86 | 1.65 | 2.11 | 2.66 |
| 1 1/16" | 2.38 | 1.90 | 1.69 | 2.15 | 2.70 |
| 1 1/4" | 2.56 | 2.09 | 1.86 | 2.32 | 2.87 |
| 1 7/16" | 2.76 | 2.30 | 2.04 | 2.50 | 3.04 |
| 1 1/2" | 2.84 | 2.39 | 2.12 | 2.57 | 3.11 |
| 1 3/4" | 3.16 | 2.72 | 2.42 | 2.86 | 3.41 |
| 1 23/32" | 3.21 | 2.76 | 2.46 | 2.91 | 3.45 |
| 1 15/16" | 3.45 | 3.02 | 2.68 | 3.12 | 3.66 |
| 2" | 3.54 | 3.12 | 2.77 | 3.20 | 3.75 |
| 2 1/4" | 3.97 | 3.56 | 3.17 | 3.59 | 4.13 |
| 2 1/2" | 4.46 | 4.01 | 3.61 | 4.03 | 4.56 |
| 2 3/4" | 4.97 | 4.50 | 4.10 | 4.50 | 5.04 |
| 3 1/4" | .... | .... | 5.22 | 5.59 | 6.12 |
| 3 3/4" | .... | .... | .... | 6.87 | 7.39 |
| 4 1/4" | .... | .... | .... | .... | 8.82 |
| 4 3/4" | .... | .... | .... | .... | 10.46 |


**REFERENCES**

[1] API Production Bulletin 230, 1943.

[2] Caraway, A. Ed. "How to Calculate Well Loads and Select Pumps." Petr. Engr. June, 1948.

[3] Kemler, Emory. "The Design of Sucker Rod Strings." Petr. Engr. Jan., March, April, 1936.

[4] Coberly, C. J. "Estimating Plunger Travel," API Production Bulletin 207, 1931.

[5] Slonneger, J. C. "Vibration Problems in Oil Wells" API Drlg. & Prod. Prac. 1937.


**TABLE 6**

**Well Study**

WELL DATA { Depth—10,000 Feet; Stroke—64"; S.P.M.—12; Tubing—2"—2.47 Lbs.; Rods—Tapered—7/8", 3/4", 5/8" (See Table 4)

| PUMP SIZE | Pump Over Travel Chart 6 | Rod Stretch Chart 4 | Tubing Stretch Chart 5 | TUBING NOT ANCHORED | | TUBING ANCHORED | | Polish Rod Load |
|---|---|---|---|---|---|---|---|---|
| | | | | Net Stroke | Production Bbls./Day | Net Stroke | Production Bbls./Day | |
| 1 1/2" | 20 | 74 | 24 | 0 | 0 | 10 | 31 | 27,300 |
| 1 1/4" | 20 | 54 | 16 | 14 | 31 | 30 | 66 | 23,870 |
| 1 1/16" | 20 | 40 | 12 | 32 | 50 | 44 | 69 | 21,700 |
| 1" | 20 | 35 | 10 | 39 | 55 | 49 | 69 | 21,250 |
| 7/8" | 20 | 28 | 8 | 48 | 51 | 56 | 61 | 20,100 |

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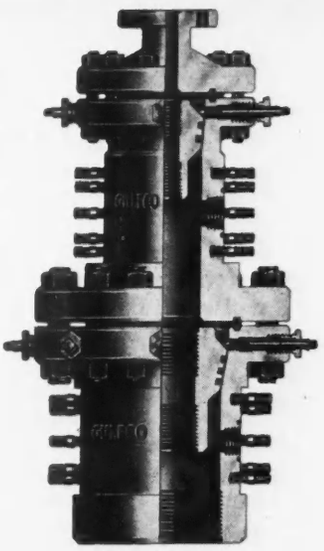
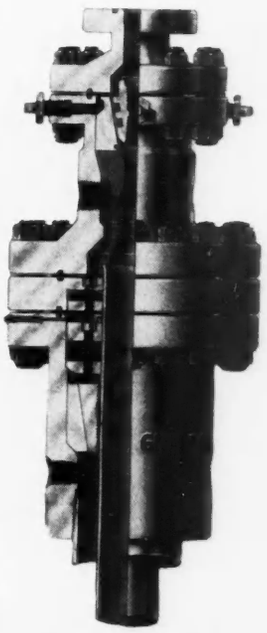
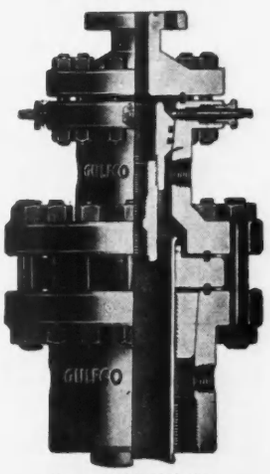


Type MF-NCF



Type K2-NC-SMF



Type CHS-NC-2F

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- Casing Head and Tubing Head Adapters
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# Well Interference Supports Wide Spacing

By GEORGE R. ELLIOTT

Phillips Petroleum Company, Bartlesville, Okla.

SOME of the confusion which has arisen in the well-spacing problem can be resolved if three statements are clearly understood.

- A field will recover additional oil by additional wells when such wells penetrate undeveloped zones.
- The lease with more wells "captures" oil from the lease with fewer wells.
- It is sometimes profitable to drill additional wells merely to take advantage of increased current production rate.

The first statement is with respect to a field having more than one producing zone or reservoir. No disagreement exists on the necessity of drilling wells to develop every separate reservoir. A field may have been completely drilled up on uniform spacing and may have produced for several years. It would be a normal course of development to drill additional wells for completion in a separate producing zone stratigraphically above or below the previously developed horizon.

**FIVE OIL RESERVOIRS are presented in graphical studies of production interference. In each pool, early wells had established a production decline trend over a period of years. Interference from later additional wells is reflected in abrupt downward changes in the trends of rate-time and rate-cumulative curves. This paper was delivered at the spring meeting of the Mid-Continent District of the API's Division of Production in Amarillo, Texas, March 21-23.**

The second statement, in recognizing "capture" behavior, will help to avoid the mistake of accepting increased lease recoveries as indicators of increased pool recoveries. The fact of regional migration has been accepted since the earliest days of the petroleum industry. An 1878 ruling of a Pennsylvania court became the "Rule of Capture":

"Petroleum gas and oil . . . belong to the owner of the land, and are part of it, so long as they are on it or in it . . . but when they escape and go into other land . . . the title of the former owner is gone. If an adjoining owner drills his own land and taps a deposit of oil and gas, extending under his neighbor's field, so that it comes into his own well, it becomes his property."

The first result of the acceptance of regional migration was the drilling of additional wells to protect leases from loss of oil to offset wells. More recently it has been realized that although regional migration directly caused close spacing, the same cause provided one of the strongest arguments for wider spacing. If on a lease basis it is necessary to drill a well to keep oil from being produced by a well on another lease, then on a pool basis one of these wells is not needed.

The third statement considers the

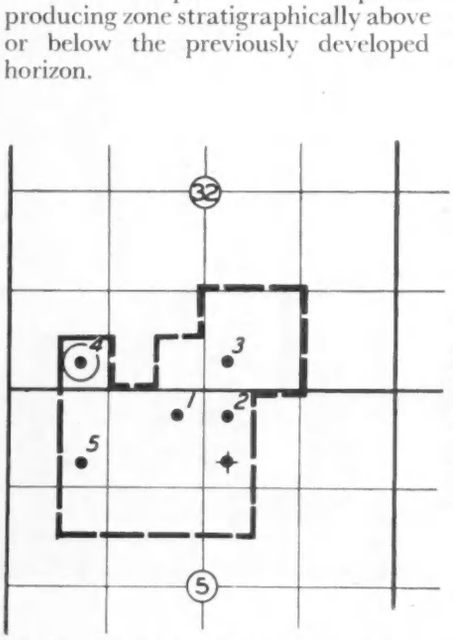



FIGURE 1. Early development status of the March pool.

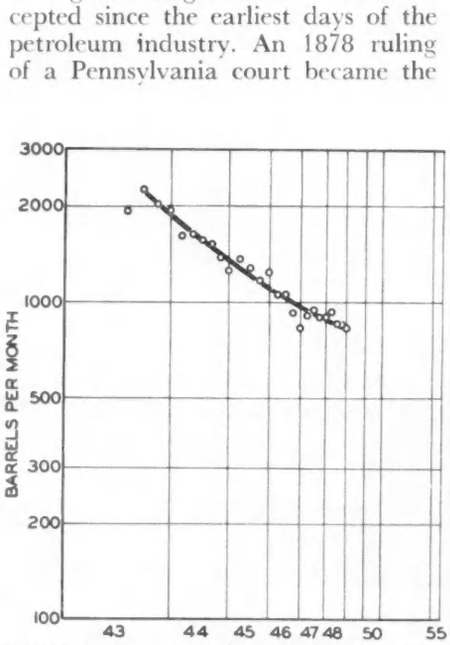



FIGURE 2. Early-established production decline curve for Well No. 4 in the March pool.

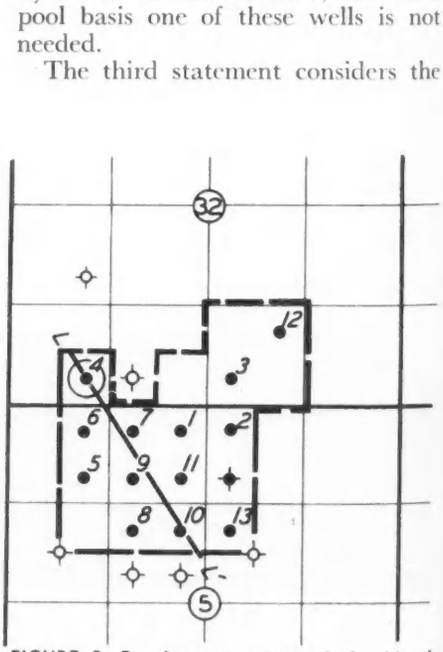


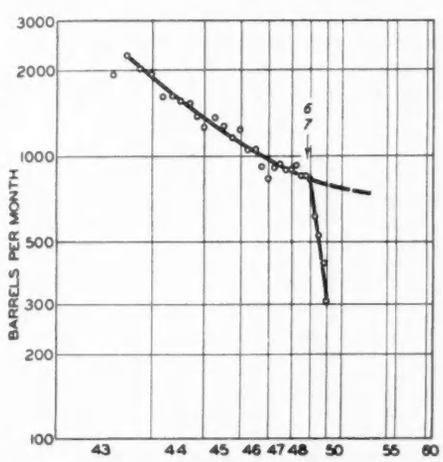

FIGURE 3. Development status of the March pool in April, 1950.

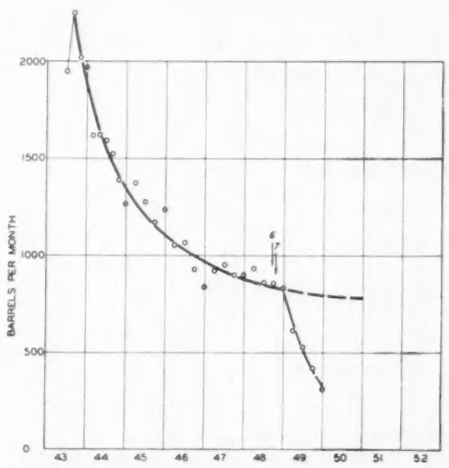
present-worth factor of the money to be received from sale of the oil when justifying the cost of drilling the additional wells. It may be profitable to increase the well density even though no additional ultimate recovery is obtained. This will be true when additional wells permit the lease a higher production rate and when this higher production rate results in a sufficient increase in the present worth to return a profit on the increased investment.

In the completion of new wells in old pools, relatively high initial producing rates attract attention. These are sometimes erroneously considered as reflecting ultimate recovery. It is useful to remember that initial potential is controlled by well bore conditions. It varies directly as the specific permeability, as the difference in pressure between the reservoir and the well bore, and as the relative permeability of the formation to oil. It is also important to consider the more effective later completion methods as compared with those employed in earlier years. Relatively high initial production rates may result from those improved completions. Another common reason for reported high initial rates arises from basing those rates on short test periods.

When wells produce unrestricted, definite decline curves are established which become sensitive indicators for interference effect from later wells. The most striking examples of interference should be found where permeabilities are highest. The difficulty here is that high-permeability wells are high-potential wells and fall under proration. This obscures the interference effect in the cases where the interference is greatest.

The normal rate-time production curve for a solution-gas-drive reservoir producing unrestricted is hyperbolic and may be represented by a straight line on log-log graph paper. If the curve departs from the straight



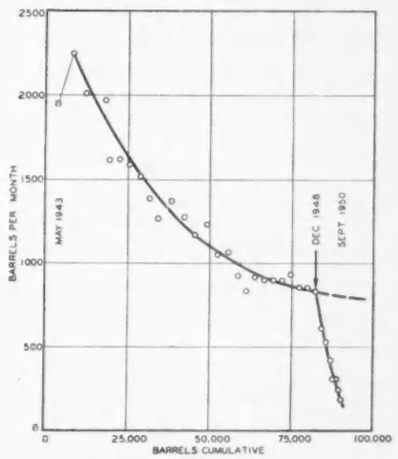
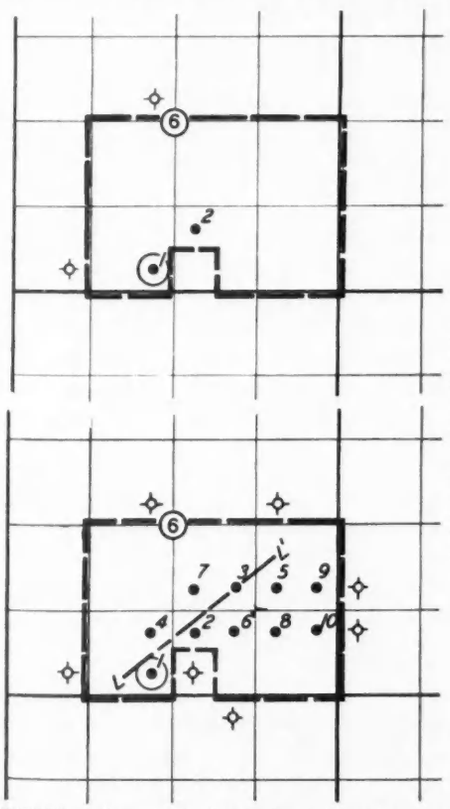
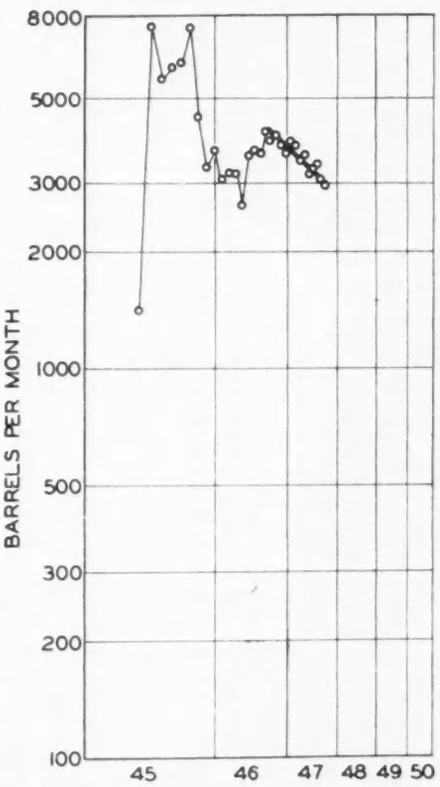




**FIGURE 4a (left). Production curve (rate-time) on log-log paper, for Well 4 in the March pool, showing interference from late wells.**
**FIGURE 4b (center). Rate-time production curve for Well 4 in March pool to illustrate interference from late wells.**
**FIGURE 4c (right). Rate-cumulative production curve for Well 4, March pool, showing interference from late wells.**



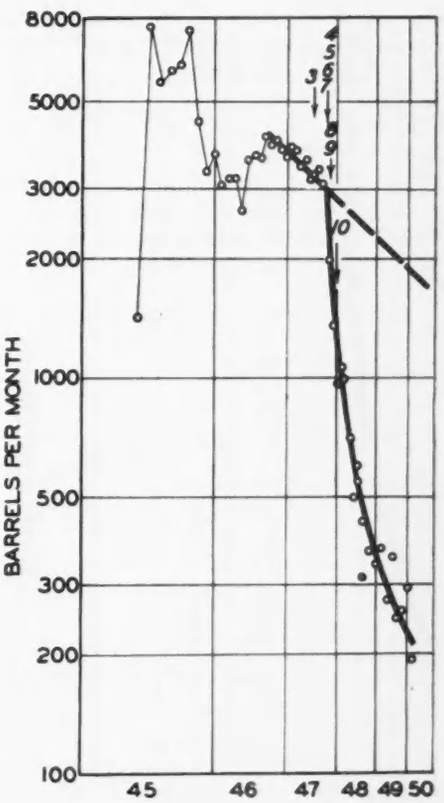
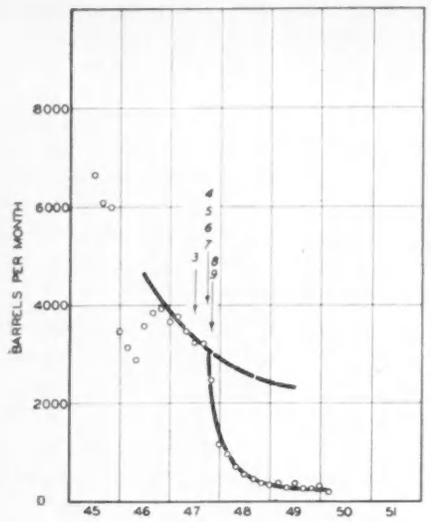
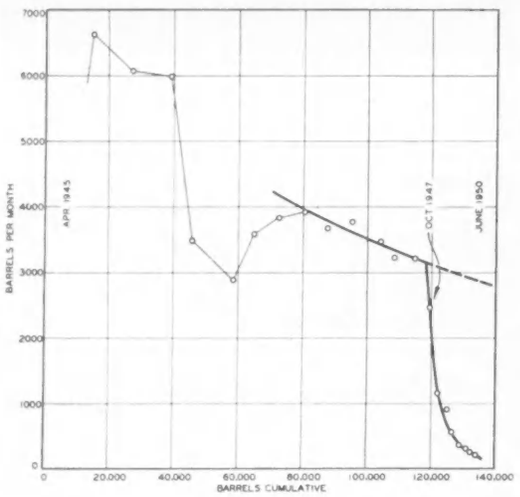




**FIGURE 5 (top left). Early development status of the Grayson pool.**
**FIGURE 6 (center). Early-established production decline curve for the Grayson pool.**
**FIGURE 7 (lower left). Complete development in 1950 of the Grayson pool.**
**FIGURE 8a (right). Production curve (rate-time) plotted on log-log paper to show interference of late wells with Well 1 in the Grayson pool.**



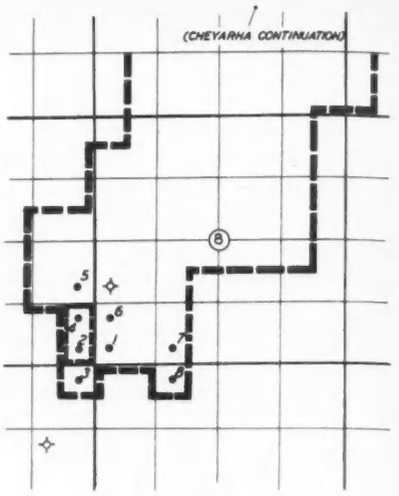
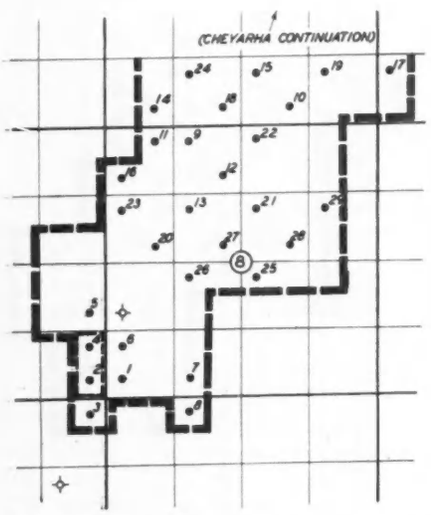
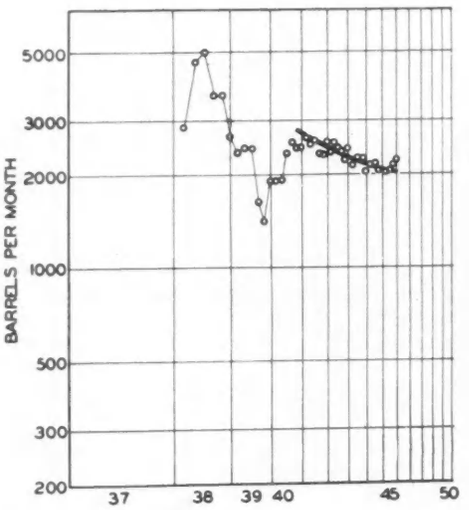




FIGURE 8b (left). Rate-time production curve of well No. 1 in the Grayson pool which illustrates interference from late wells.
FIGURE 8c (center). Rate-cumulative production curve for well No. 1 in the Grayson pool, showing late well interference.
FIGURE 9 (right). Early development status of the Cheyarha pool.



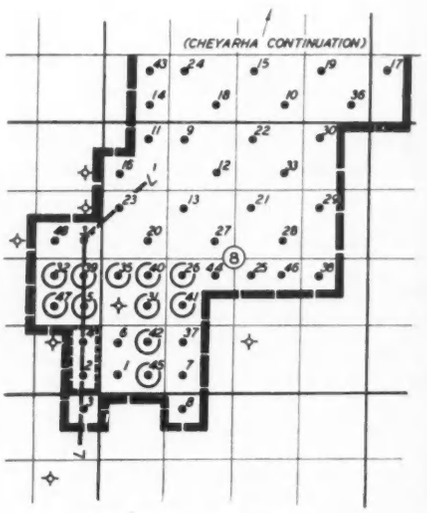
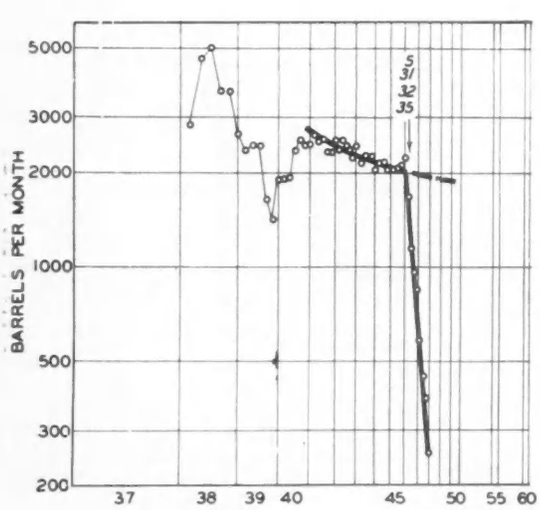




FIGURE 10 (left). Development status of the Cheyarha pool before remaining 1800-foot interval was filled.
FIGURE 11 (center). Early-established production decline curve for Wells 2-4 in the Cheyarha pool.
FIGURE 12 (right). Complete development of the Cheyarha pool in 1946.



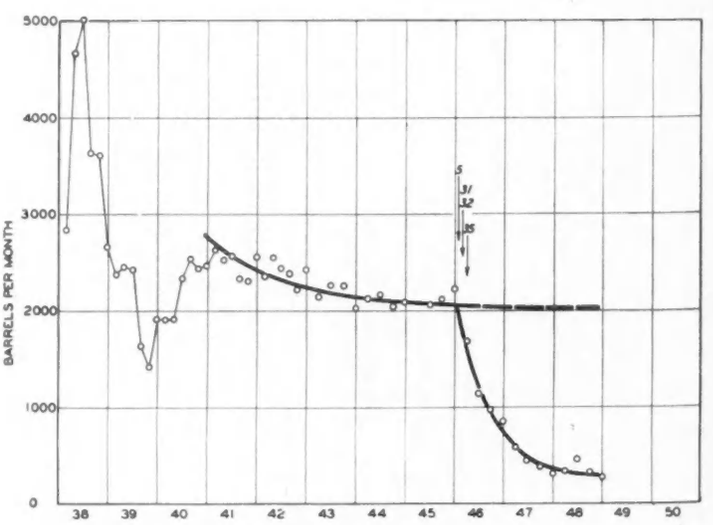




FIGURE 13a (left). Production curve (rate-time) plotted on the log-log paper to show interference of late wells with Wells 2-4 in the Cheyarha pool.
FIGURE 13b (right). Rate-time production curve of Wells 2-4 in the Cheyarha pool, showing late well interference.

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**TABLE I. COMPARATIVE COSTS FOR 50,000 MILES**

| | AUTOMOBILE @ 6¢ per mi. | RAIL @ 5¢ per mi. | PIPER PACER @ 6.5¢ per mi. |
|---|---|---|---|
| Mileage Cost | $ 3,000 (for 1 or 5) | $2,500 (for 1) | $3,250 (for 1 or 4) |
| Personnel Value* | 6,250 (for 1) | 5,000 (for 1) | 2,000 (for 1) |
| Personal Expense** | 1,560 (for 1) | 1,250 (for 1) | 500 (for 1) |
| Total Travel Costs | $10,810 | $8,750 | $5,750 |

*Personnel value is figured conservatively at $5.00 per hour times traveltime. Average speeds are figured at 50 mph for train; 40 mph for auto and 125 mph for Piper Pacer.
**Personal expenses are figured at $10 per day.

**Quite often the cost of transportation itself is the least important. Executive time and out-of-town expenses must be figured also. That's why the swift, comfortable Piper Pacer comes out ahead every time.**

**TABLE II. ANNUAL COST COMPARISON**

| MILEAGE | AUTOMOBILE | RAIL | PIPER PACER |
|---|---|---|---|
| 20,000 | $ 4,320 | $ 3,500 | $3,320 |
| 30,000 | 6,490 | 5,250 | 4,920 |
| 40,000 | 8,650 | 7,000 | 5,040 |
| 50,000 | 10,810 | 8,750 | 5,750 |
| 60,000 | 12,980 | 10,500 | 6,480 |
| 70,000 | 15,140 | 12,250 | 7,350 |
| 80,000 | 17,300 | 14,000 | 8,120 |
| 90,000 | 19,470 | 15,750 | 9,000 |
| 100,000 | 21,620 | 17,500 | 9,800 |

**Auto is figured at 6¢ per mile, rail at 5¢. Pacer rate includes all fixed costs as well as maintenance and fuel. At 50,000 miles annually, the cost per passenger-mile by Pacer is only 1.6¢ total!**

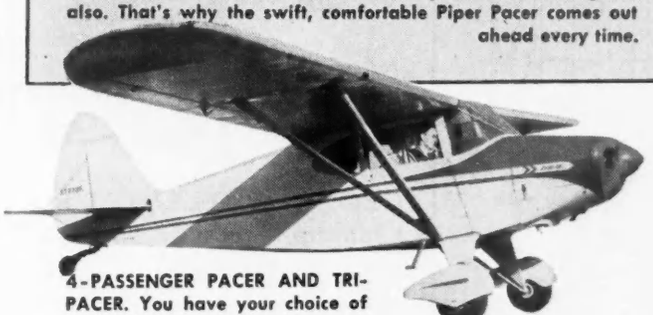

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**TABLE III. COMPARATIVE HOURS OF TRAVELTIME**

| ANNUAL MILEAGE | AUTOMOBILE @ 40 mph (avg.) | RAIL @ 50 mph | PACER @ 125 mph |
|---|---|---|---|
| 20,000 | 500 | 400 | 160 |
| 30,000 | 750 | 600 | 240 |
| 40,000 | 1,000 | 800 | 320 |
| 50,000 | 1,250 | 1,000 | 400 |
| 60,000 | 1,500 | 1,200 | 480 |
| 70,000 | 1,750 | 1,400 | 560 |
| 80,000 | 2,000 | 1,600 | 640 |
| 90,000 | 2,250 | 1,800 | 720 |
| 100,000 | 2,500 | 2,000 | 800 |

**Look at it either way. You spend lots less time travelling by Pacer, or you can make more necessary trips in the same amount of time. By Pacer it's nothing to fly as much as 500 miles to make a call and return the same day.**

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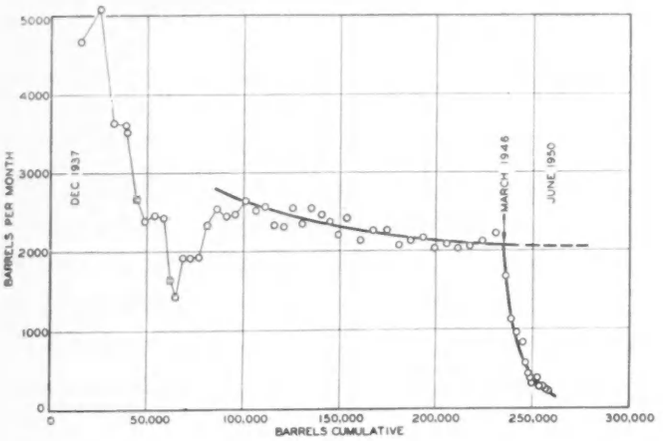
line and tends to parallel the time axis, this may be due either to the presence of some natural water drive or to expansion of the supporting area into an undeveloped portion of the reservoir. Whatever pattern the decline takes, the curve can still be used as an indicator of interference.

Many prefer the rate-cumulative curve because of the direct reading of cumulative barrels instead of years. In the case of wells approaching the economic limit, the rate-cumulative curve declines more sharply than does the rate-time curve and more clearly emphasizes the small future recovery expected from such wells.

A bibliography is appended. A thorough perusal of this literature will still leave the reader with a feeling that more field evidence is needed. The definite need for such field data is the main reason for contributing the present paper.

The most promising opportunity of acquiring direct field evidence arises from the drilling of additional wells in a reservoir which has already established a decline trend. This situation of new wells in old reservoirs has resulted from: (1) removal of the wartime 40-acre spacing rule; (2) increase in the price of crude oil; and (3) desire to increase current producing rate. Examples usually represent the drilling of good wells and their interference effect on poor wells. Poor early wells constitute the usual reason why the field has continued



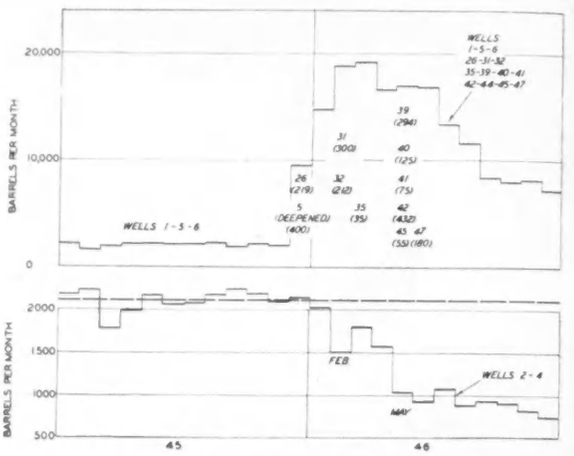




FIGURE 13c (top left). Rate-cumulative production curve for wells 2-4 in the Cheyarha Pool showing interference from late wells.

FIGURE 14 (above). Details of late well interference with wells 2-4 in the Cheyarha Pool, plotted on a monthly basis.

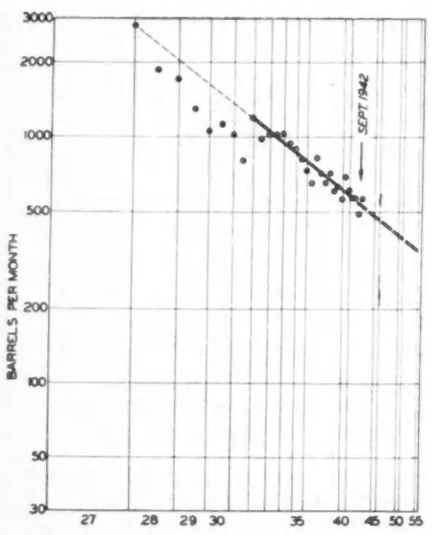



FIGURE 15. Early-established production decline curve for Well 1 in the West Agra pool.

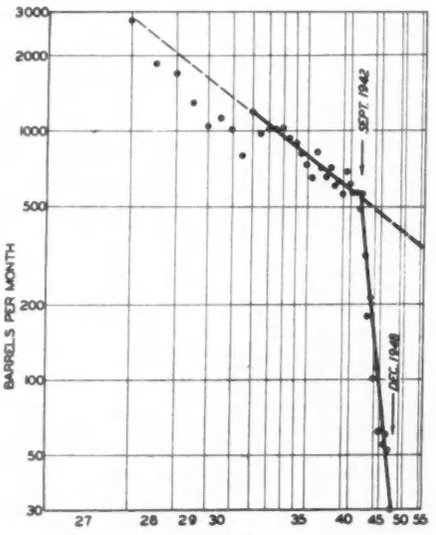



FIGURE 17a. Production curve (rate-time) of Well 1 in West Agra pool, plotted on log-log paper to show interference from late wells.

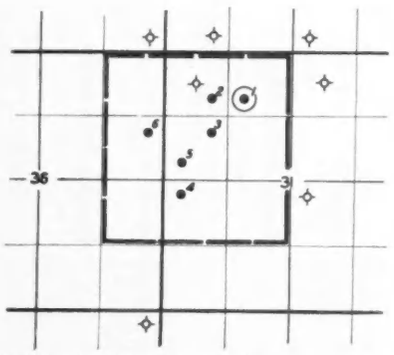



FIGURE 16. Complete development status of the West Agra pool in 1948.

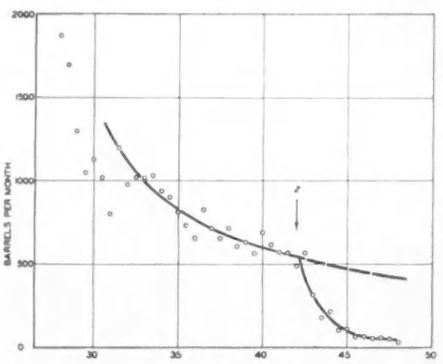
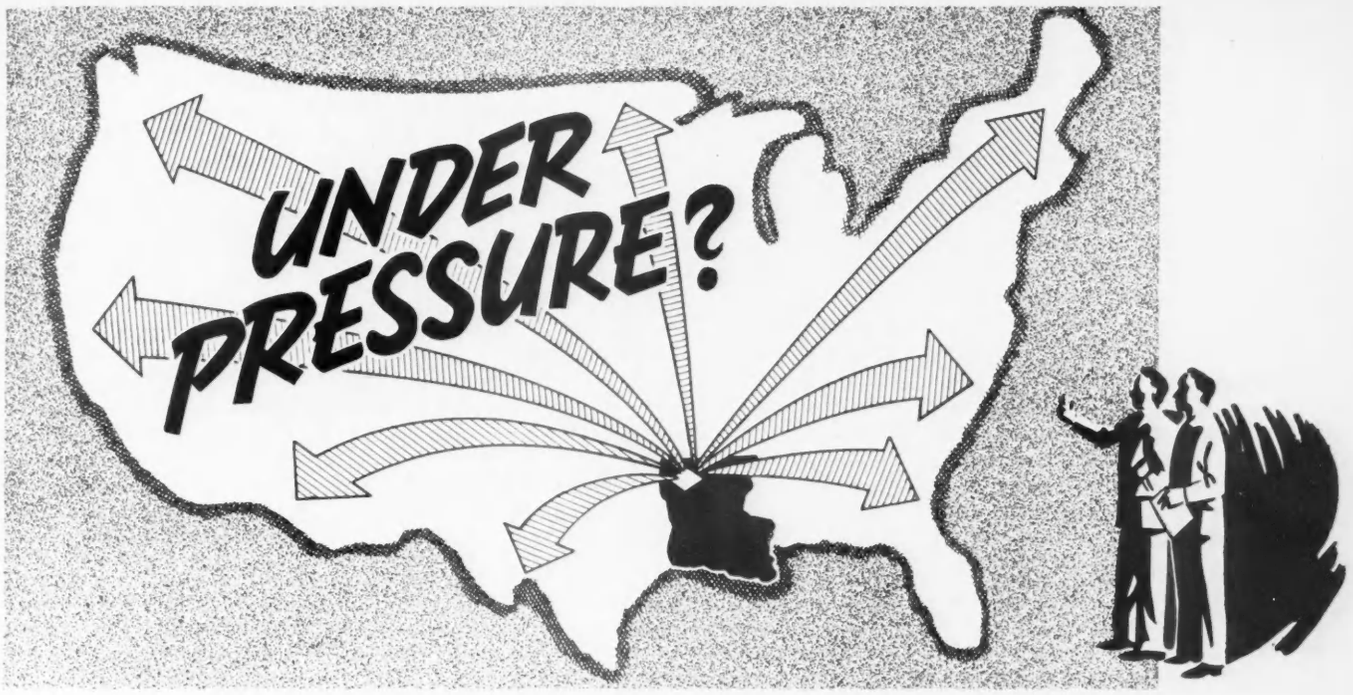



FIGURE 17b. Rate-time production curves of Well 1 in the West Agra pool to illustrate late well interference.

## About the Author

GEORGE R. ELLIOTT has been continuously associated with reservoir studies and their application to oil field problems since he joined Phillips Petroleum Company's Production department in 1936. He received his B.A.Sc. degree from the University of Toronto, and did graduate work at Columbia University. He joined Phillips after 14 years' varied experience in Oklahoma, California and Alberta.

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incompletely developed. Early wells being edge wells with low initial potentials failed to encourage operators to further development until more favorable price conditions arose. Thus, the usual situation is the drilling of late wells between less productive edge wells and the more productive part of the reservoir. If the discovery well had penetrated the most productive section, it is probable that no delayed drilling example would appear. As might be expected, pool production curves indicate that the drilling of additional centrally located wells will usually result in greater ultimate recovery from the reservoir than would have been obtained from the early edge wells by themselves.

Five fields are used as sources of production interference examples. In each case a well has established a decline trend over a period of years. This decline pattern is represented by a rate-time curve and a rate-cumulative curve. Following the several years of established decline, additional wells were drilled. An interference effect is shown by an abrupt break downward in the decline curve of the well under observation. Any prediction of future ultimate recovery based on the former established decline curve is now of no value. It is necessary to substantially reduce the expected future recovery from the well in conformance with the new decline curve. This reduction represents the interception and diversion of oil. Oil that had established a flow pattern toward the old well is intercepted and diverted from the old well to be produced by the new wells.

EXAMPLE ONE: The March Bartlesville Sandstone pool, Twps. 17 and 18n, R5e, Payne County Oklahoma, is the first example. Average depth is 3600 feet and average thickness is 15 feet. Figure 1 shows the development status as it remained during the five years 1943-1948. The discovery well, No. 1, was completed in June, 1928, for 50 barrels per day. About one year later, the east and northeast ten-acre offsets were completed for 78 and 80 barrels per day, respectively. Wells 4 and 5 were completed in 1943, on 40-acre spacing and there was then no further development for five years.

Well 4 (circled in Figures 1 and 3) remained as a one-well lease throughout, and it is possible to observe the effect on it of increasing the well density in the pool. The production curve established by No. 4 during the five-year period is shown in Figure 2. In October, 1948, the south ten-acre offset to No. 4 was completed (No. 6 well) and in November, the southeast ten-acre offset was completed (No. 7 well). These two wells produced 2400 barrels per month during the last quarter of 1948. No more wells were completed for one year.

Figure 3 shows the filled-in ten-acre spacing development as of April, 1950. Figures 4a, 4b and 4c show the

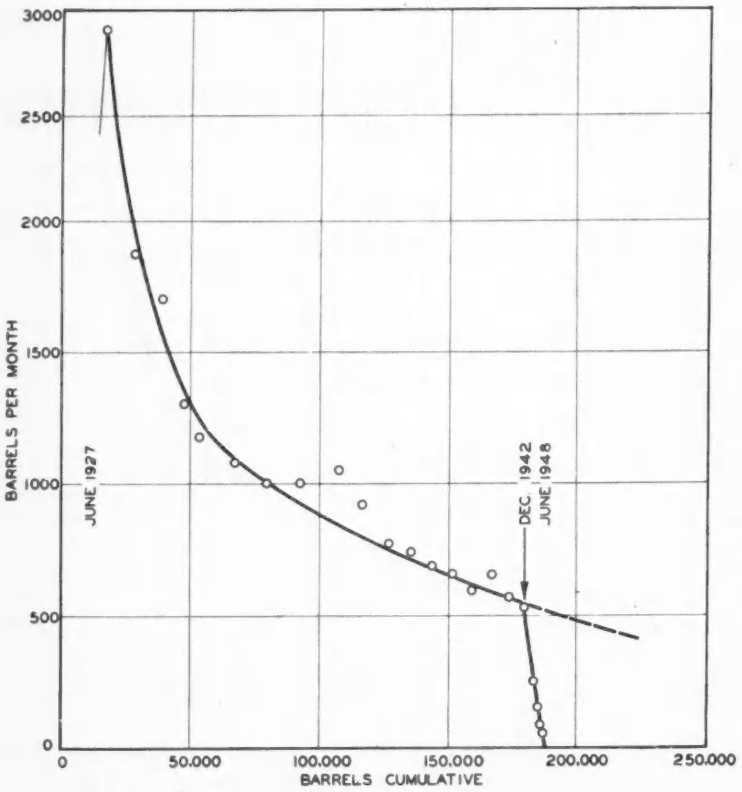



FIGURE 17c. Rate-cumulative production curve for Well 1 in the West Agra pool showing interference from late wells.

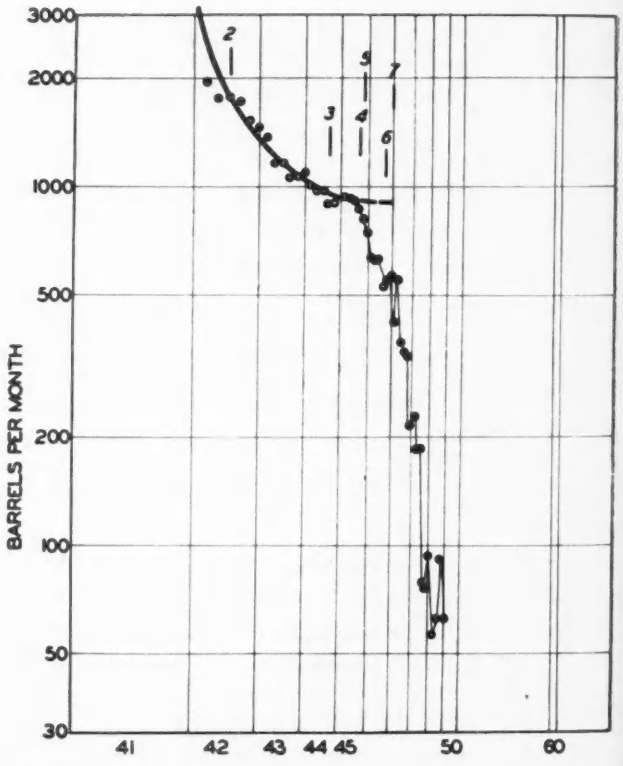



FIGURE 19a. Production curve (rate-time) of Well 1 in the Milfay pool as plotted on log-log paper to show interference from late wells.

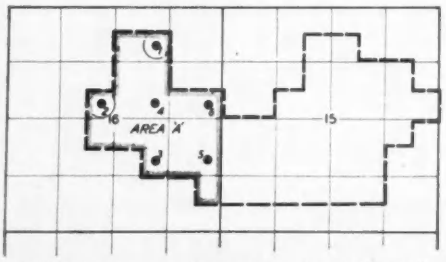
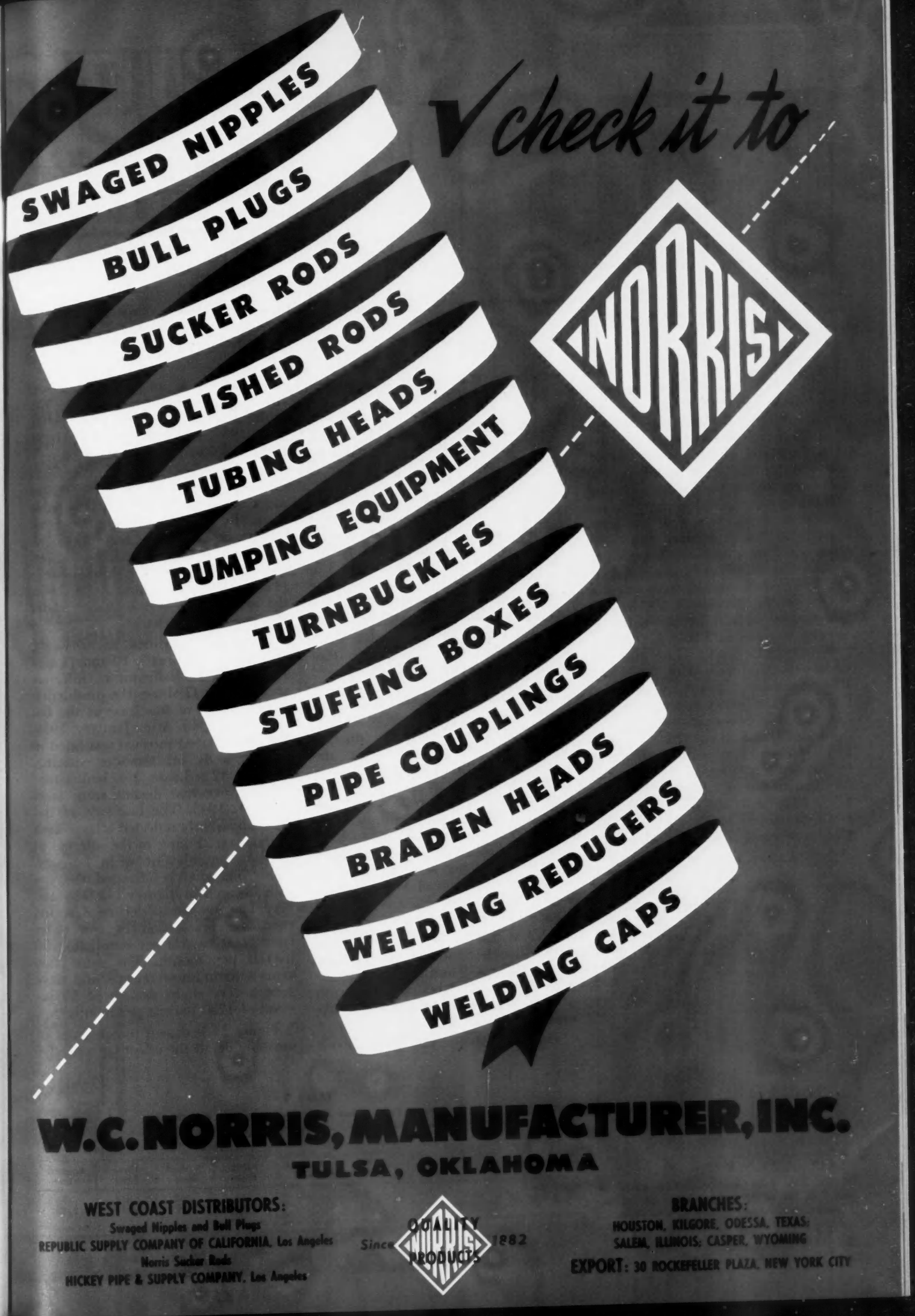



FIGURE 18. Status of completion in 1946 of 40-acre development of the Milfay pool.

TABLE 1

Well Production—Barrels of Oil

| | 1948 | | | | | | 1949 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June |
| Well No. 4, Quarterly Avg. | .... | 858 | .... | .... | 828 | .... | .... | 611 | .... | .... | 526 | .... |
| Well 4 | 930 | 744 | 900 | 744 | 840 | 899 | 538 | 532 | 744 | 720 | 527 | 330 |
| Wells 1, 5 | 713 | 650 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Wells 1, 5, 6 | .... | .... | 1560 | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Wells 1, 5, 6, 7 | .... | .... | .... | 3007 | 3090 | 3162 | 2449 | 2380 | 2666 | 2460 | 2046 | 2130 |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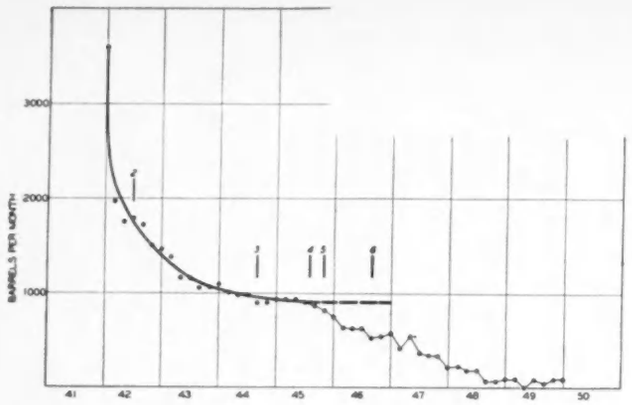


FIGURE 19b. Rate-time production curve of Well 1 in the Milfay pool to show late well interference.

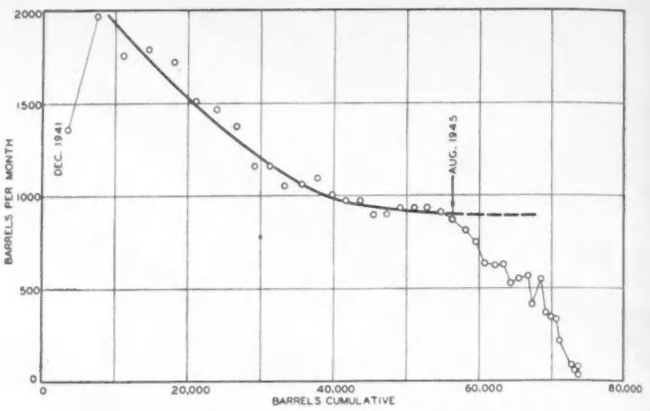


FIGURE 19c. Rate-cumulative production curve of Well 1 in the Milfay pool to show interference of late wells.

resulting interference with the production of No. 4 well. The first quarterly point in 1949 begins a steep departure from the previous flat decline as a result of the completion of wells 6 and 7. The magnitude of the interference is reflected in the following production rates. During 1949, immediately following the completion of Wells 6 and 7, the production of No. 4 declined from 800 barrels per month to 300 barrels per month. On the old decline trend during 1949, there would have been a decline of 40, instead of 500 barrels per month. Month by month comparison is given in Table 1.

EXAMPLE TWO: The Brayson Cromwell Sandstone pool, Twp. 6n, R6e, Seminole County, Oklahoma, has a depth of 3000 feet and the average pay thickness is 20 feet.

In April and May, 1945, the first two wells were completed as diagonal ten-acre offsets (Figure 5). There was no further completion until May, 1947. Monthly runs have been separately recorded for No. 1 well (circled in Figures 5 and 7), and it is possible to observe the effect on it of additional drilling. Figure 6 shows the production history of No. 1 over the early period 1945-1947.

Eight additional wells in the latter part of 1947 brought the total to ten on ten-acre spacing, (Figure 7). Figures 8a, 8b and 8c show how the later wells interfered with the production of No. 1 well. The production of No. 1 was apparently not affected by the completion of No. 3 in May, 1947, No. 1 continuing the same decline trend until September.

Well 4, a direct north ten-acre offset, was completed in August, 1947, but produced only 155 barrels that month. In September, No. 4 produced 1650 barrels and in October, 3751 barrels. These figures for No. 4 directly correlate with a drop of 1000 barrels per month in the production of No. 1 between September and October. In 15 months to the end of 1948, production declined from 3000 barrels per month to 400 barrels per month. On the old trend, without interference, the decline would have been 600 instead of 2600 barrels per month. September and October also saw the completion of Wells 5, 6, 7, 8 and 9, all farther from No. 1 than 40-acre spacing distance.

EXAMPLE THREE: The Cheyarha Booch Sandstone pool is located in Twps. 9 and 10n, R7e, Seminole County, Oklahoma, at a depth of 3600 feet, with an average thickness of 28 feet.

Figure 9 shows the early Booch development in an area which was then included in East Seminole. No. 1 discovered the Booch reservoir in July, 1937, and by November, 1938, eight wells had been completed.

In January, 1944, the Cheyarha discovery well was completed three miles northeast of the East Seminole Area. By January, 1946, the Cheyarha development had extended southwest on 20-acre spacing to 1800 feet from the older group of wells (Figure 10). (Beginning April, 1946, the older group was included under the name Cheyarha.)

Lease 2-4, outlined by a heavy dash line in Figures 9, 10 and 12 was selected as an indicator of interference. Figure 11 shows the production decline trend of this lease at the beginning of 1946. After January, 1946, the undeveloped interval was filled in by 12 wells on ten-acre spacing. (Figure 12.) Lease 2-4 had established a five-year decline trend during 1941-1945. The low rate of decline apparently reflected a large area of drainage. Filling in the interval to the northeast, beginning in January, 1946, immediately changed the decline, as seen in Figures 13a, 13b and 13c. The new steep decline dropped the lease production in two years from 2000 barrels per month to 250 barrels per month. The same two years without interference would have seen a very slight decline of 50 instead of 1750 barrels per month.

Figure 14 is drawn to bring out in monthly detail the effect on wells 2-4

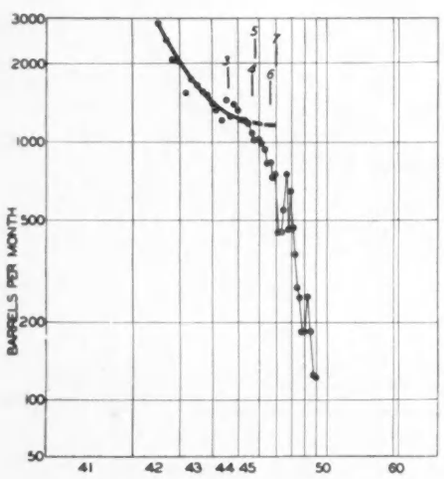


FIGURE 20a. Rate-time production curve of Well 2 in the Milfay pool, plotted on log-log paper, to show interference of late wells.

**TABLE 2**
**Half-Year Production Averages—Barrels Per Month**

| | 1941 | | 1942 | | 1943 | |
|---|---|---|---|---|---|---|
| | First Half | Second Half | First Half | Second Half | First Half | Second Half |
| No. 1 Well | 570 | 567 | 488 | 567 | 317 | 180 |
| No. 2 Well | .... | .... | .... | 867 | 1179 | 1189 |

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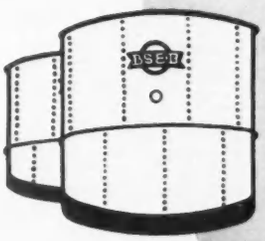


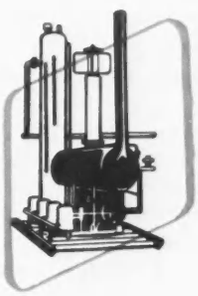

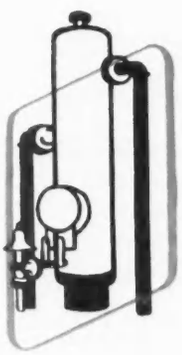

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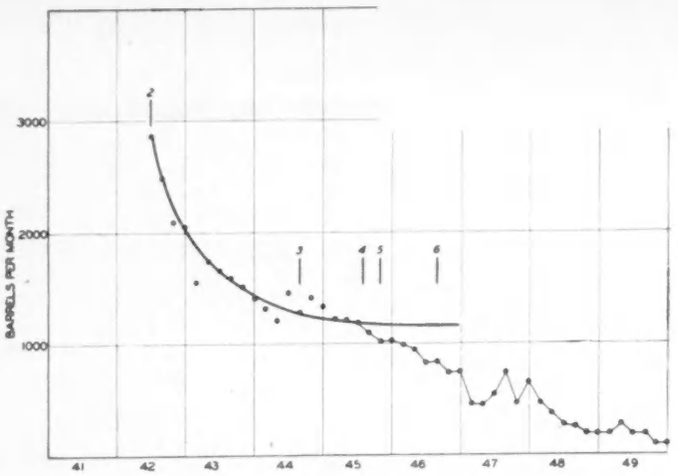


FIGURE 20b. Rate-time production curve of Well 2 to show late well interference in the Milfay pool.

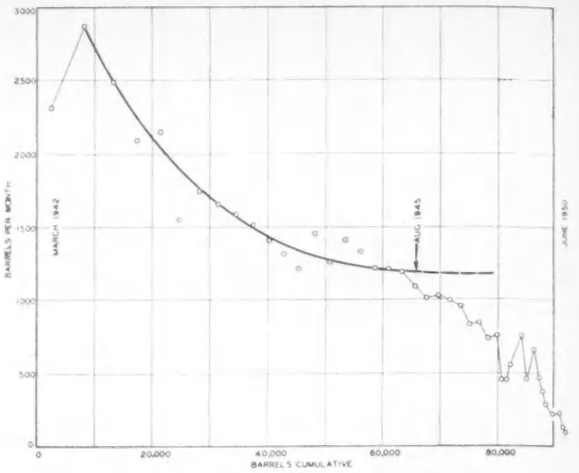


FIGURE 20c. Rate-cumulative production curve of Well 2 in the Milfay pool showing interference from late wells.

production of the new completions circled in Figure 12. The lower part of the graph represents monthly production of Wells 2-4. The upper part of the graph represents total monthly production of the group of possibly interfering wells. The upper graph through November, 1945, shows the production of offset Wells 1, 5 and 6. (No. 3, south offset, is a small well whose production could not be separated from its lease total.) Beginning with December, the individual completions are shown by well number and initial daily potential. December completions are No. 26 and No. 5 (deepening). The moderate drop in January is probably due to recompletion of No. 5, north offset. The large drop in February can be attributed to the completion of Wells 31 and 32, each 1400 feet distant from Well 4. The large drop in May can be attributed mostly to Wells 39 and 42, each 1320 feet distant from Well 4.

EXAMPLE FOUR: The West Agra Cleveland Sandstone pool, with a depth of 3100 feet and average thickness of eight feet is located in Twp. 17n, R3 and 4e, in Lincoln County, Oklahoma.

The discovery of this pool produced alone for 15 years from 1927 to 1942. For the last 11 years, production had followed a straight line log-log decline (Figure 15).

The second well was a west ten-acre offset (Figure 16) and was completed in September, 1942. The interference effect on the production of No. 1 (circled in Figure 16) is shown in Figures 17a, 17b and 17c. Interference of the second well reduced No. 1 from 600 barrels per month to 200 barrels per month. On the old trend without interference, the decline would have been only 100 instead of 400 barrels per month. The same steepened decline trend continued as No. 3 and later wells were completed. The following comparison of half-year averages, barrels per month, provides a measure of the interference in barrels of production.

EXAMPLE FIVE: The last illustration of well interference cited is that of the Milfay Wilcox Sandstone pool in Twp. 15n, R7e, Creek County, Oklahoma. It is at a depth of 3900 feet with an average sand thickness of 94 feet which was reduced by oil-water contact.

The west area of this pool was first developed by six wells on 40-acre spacing (Figure 18). The first two wells were completed in 1941-1942, and the other four completed in 1944-1946. Wells 1 and 2 are circled in Figure 18. The production

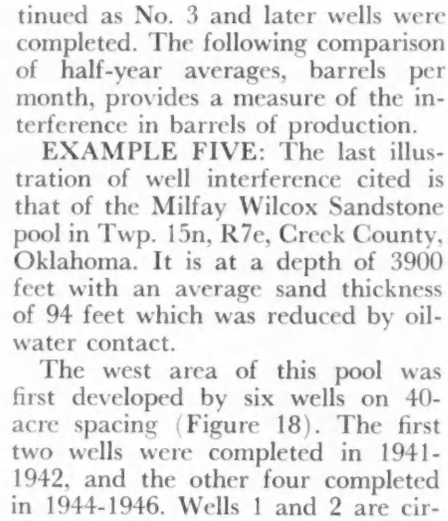


FIGURE 21. Production on monthly basis of Wells 1 and 2 over three-year period to show details of late well interference in the Milfay pool.

curve of No. 1 is drawn in Figures 19a, 19b and 19c. The production curve of No. 2 is drawn in Figures 20a, 20b and 20c. These production curves show the interference from Wells 3, 4, 5 and 6. No. 4 is the nearst well, one 40-acre location distant and the interference effect begins with the completion of No. 4. During the 16 months to the end of 1946, production of No. 1 well declined from 900 barrels per month to 500 barrels per month. On the old trend, the decline would have been ten barrels instead of 400 barrels per month. During the 18 months to the end of 1946, production of No. 2 declined from 1200 barrels per month to 700 barrels per month. On the old trend, the decline would have been 50 barrels instead of 500 barrels per month.

Figure 21 is a correlation between the two-month average oil runs of Wells 1 and 2 and those of possible interference Wells 3, 4, 5 and 6. No. 3 is 2640 feet south of No. 1 and 1800 feet southeast of No. 2. No interference from No. 3 is apparent in the production of either No. 1 or No. 2. No. 4 is 1320 feet south of No. 1 and 1320 feet east of No. 2. Definite interference appears on production curves of both 1 and 2 as soon as No. 4 is completed.

## Summary and Conclusions

These five examples illustrate definite production interference between wells at distances ranging from 660 to 1400 feet. It is concluded that in these examples wells were spaced closer than necessary from the standpoint of ultimate recovery of oil from the pool. Wells need not have been drilled as close as ten-acre spacing or even as close as 40-acre spacing.

Interference has resulted from the intercepting and diverting of oil to

late wells from an established movement to early wells. In all cases, the early wells were edge wells and the late wells were drilled between the early wells and the more productive portion of the reservoir. In each of these instances, the pool would not have recovered as much oil from the early wells alone as with the drilling of the additional wells.

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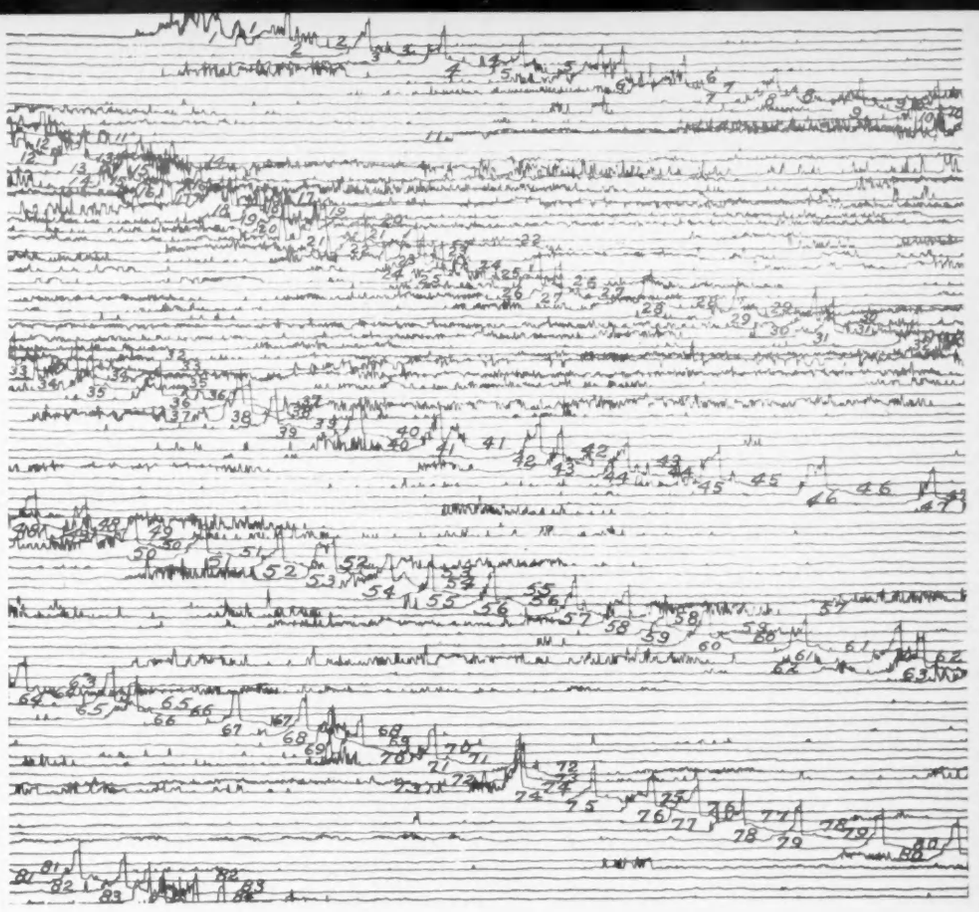


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# Permeability Constancy Range of a Porous Medium

By R. F. NIELSEN

The Pennsylvania State College, State College, Penn.

**FACTORS CAUSING variations in measured values of single-fluid permeability are reviewed briefly. In particular, the conditions under which departure from purely viscous flow may be expected are pointed out. In the case of high permeability cores, errors in the "Klinkenberg factor" might easily be made unless pressure gradients are kept low. A nomograph has been constructed showing the pressure gradient which should not be exceeded in measurements with air.**

VARIATIONS in the single-fluid permeability of a porous medium with the nature of the fluid used for the measurement has been the subject of numerous studies. Factors causing such variations, aside from incomplete saturation and other experimental errors are as follows:

- Reaction of the fluid with the solid, causing a change in pore pattern,
- "Slip" in the case of gases,
- Electro-kinetic or frictional electric effects,
- Departure from purely viscous flow.

The most common example of a reaction with the solid, as far as oil sands are concerned, is "clay swelling." This reaction is in general an ionic exchange reaction involving water or an aqueous solution.[1] Other reactions involving the solid may include chemical or physical removal of material with or without subsequent deposition. Changes in the flow channels may also be caused by bacteria or by release of gas or another phase from a flowing liquid. Such reactions are usually circumvented in permeability measurements by an expedient choice of fluid.[2, 3]

The phenomenon of slip in the flow of gases through capillaries was pointed out to the oil industry by Klinkenberg.[4] He also demonstrated a practical way of correcting permeability measurements for slip that is now well known and widely used in laboratories.[2, 3, 5]

Electro-kinetic phenomena involving a porous solid and water or an aqueous solution have long been known and are discussed at length in texts on physical and capillary chemistry. Electrical effects involving flow of a non-polar liquid through a porous solid are not so well known.[6] These are discussed later in this paper. Klinkenberg used a solution of ferric thiocyanate in nitrobenzene to avoid electrical effects in the measurement of liquid permeabilities.

In the absence of the three factors just mentioned, Darcy's Law applies and the permeability of a sample of a porous medium is in general independent of the fluid and the pressure gradient used, as long as the flow is strictly viscous. As long as this condition exists, the stream lines are the same and the velocity ratio along any given pair of streamlines is constant. If the pressure gradient is increased indefinitely in any given case, a velocity is reached such that the flow departs from purely viscous flow, and turbulence occurs.

Conditions that determine whether the flow will be viscous or turbulent have been the subject of much study in particular in relation to flow in conduits. A review of these factors is given by Muskat.[7] The most useful criterion for determining the transition conditions is the Reynolds number, a dimensionless group defined as

$$\mathrm{Re} = \frac{\mathrm{dv}\rho}{\mu} \qquad (1)$$

where d is the diameter of the conduit v the average linear velocity in the conduit, $\rho$ the fluid density and $\mu$ the fluid viscosity, all units being consistent.

For similar geometric systems it has been found that the transition from viscous to turbulent flow takes place in the neighborhood of a given Reynolds number. In the case of smooth cylinders this is about 1000.

Extensive studies on the validity of Darcy's law for porous media were made by Fancher, Lewis, and Barnes.[1] They followed the practice of hydraulic engineers of plotting the friction factor of Fanning's equation against the Reynolds number. Their *d* was an average grain diameter obtained from a sieve analysis. According to their plots, Darcy's law applied strictly at values of the Reynolds number below about unity. Lindquist[8] found, employing columns of shot, that the product of the friction factor and Reynolds number was a linear function of the Reynolds number above values of about 2, *d* being the diameter of the shot.

More recent experiments[2, 9, 10] in Pennsylvania State College laboratories, involving the flow of naphtha and other organic liquids through consolidated cores, have shown a decrease in apparent permeability with pressure gradient. This was at first believed to be due, in part at least, to the frictional electrical effect of a non-polar liquid mentioned previously. In fact attempts were made[9, 11] to measure the potential drop by inserting metal wires into the fluid at the two ends of the core and connecting these wires to a sensitive millivoltmeter. Readings could be obtained which, for any given core at a given time, were proportional to the fluid velocity, which was varied by changing the pressure gradient. However, the readings seemed to depend on atmospheric conditions and readings could not be duplicated on different days. The readings are not an accurate measure of the actual potential difference because of the extremely high resistance of the external (naphtha) part of the circuit. That the actual potentials generated can be very high has been shown by the fact that sand packed tubes being loaded with naphtha often crackle and show sparks. This phenomenon usually oc-

curs when the sand, tube, and naphtha are well dried and the relative humidity of the room is low.

Subsequent studies[11] involving organic liquids led to the conclusion that the apparent decrease in permeability with pressure gradient is due mainly to departure from viscous flow. Two lines of observation led to this conclusion. The first was that while the electrical effects depended on humidity conditions the trend in apparent permeability did not. The second was that the permeability trend was associated with flow conditions above a certain Reynolds number. In a series of measurements by Traugh[11] cores of a large range of permeabilities were used, and both the pressure gradient and fluid viscosity were varied. In calculating the Reynolds number a type of "statistical" pore diameter was calculated from the porosity and permeability. The assumptions made are that the core is composed of a bundle of parallel cylindrical capillaries yielding the same permeability and porosity. The formula,[3] obtained from geometry and Poiseuille's and Darcy's laws, is

$$d = 17.7 \times 10^{-6} \sqrt{k/f} \qquad (2)$$

where d is the capillary diameter in centimeters, k the permeability in millidarcys, and f the porosity expressed as a fraction.

Traugh found, in agreement with previous investigators, that the Reynolds number above which the apparent permeability decreased with velocity was more or less independent of the fluid and porous medium. This number was slightly less than that given by Fancher, Lewis, and Barnes, being in the range of 0.1 to 0.5. The difference may be due to the method of calculating the pore diameter. For instance, the mean sand grain diameter would be expected to be larger than the mean pore diameter.

While the importance of keeping permeability measurements within the viscous range is generally recognized, many measurements have been made without regard for this precaution. This is seemingly due to lack of knowledge of the maximum pressure gradient that will allow purely viscous flow in a given case. While it may be known that the Reynolds number should not exceed 0.1, it would be more useful to know what pressure gradient must not be exceeded in a given measurement. This may be calculated by the use of the foregoing equations and Darcy's Law.

The average linear velocity of the fluid is the flow in cubic centimeters per second per square centimeter cross section divided by the porosity. Thus

$$v = \frac{K \triangle P}{76{,}000\, f\, \mu\, l} \qquad (3)$$

where K is the permeability in millidarcys $\Delta P$ the pressure drop across the core in centimeters of mercury, f the fractional porosity, $\mu$ the fluid viscosity in centipoises, and l the core length in centimeters. Substituting for d and v from Equations 2 and 3 and putting the viscosity in centipoises, the expression for the "Reynolds number," Equation 1, becomes

$$Re = \frac{0.0017\, K^{1.5}\, \rho\, \triangle P}{76{,}000\, \mu^2\, f^{1.5}\, l} \qquad (4)$$

If it is assumed that departure from purely viscous flow may take place at a "Reynolds number" as low as 0.1, then the value of $\Delta P$ must be kept below

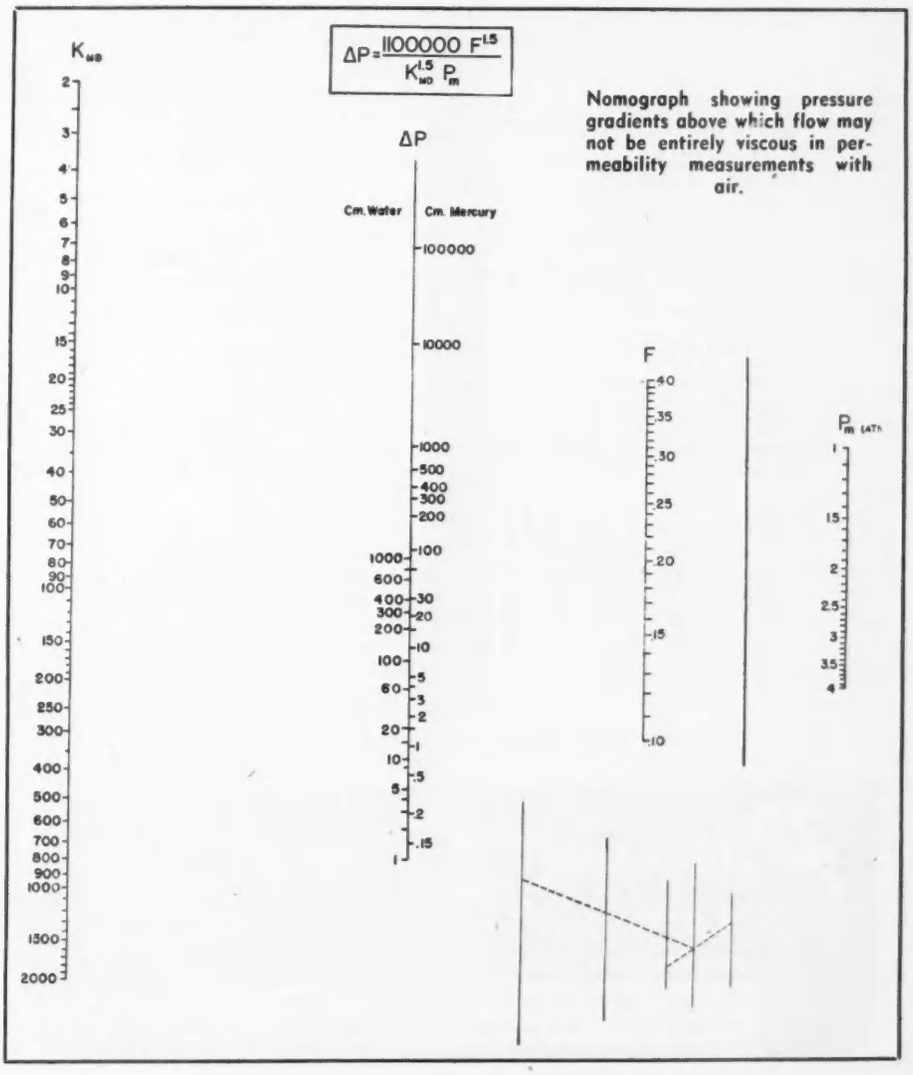
$$\underset{max}{\triangle P} = \frac{4.5 \times 10^6\, \mu^2\, f^{1.5}\, l}{\rho\, K^{1.5}} \qquad (5)$$

Equation 5 may therefore serve as a guide in any given permeability determination to determine whether the pressure drop used is excessive for a reliable measurement. This may be illustrated with an example in which naphtha is used. If $\mu = 0.48$, $f = 0.2$, $l = 2$, $k = 850$, and $\rho = 0.7$, then $\Delta P$ max = 10.5 cm. of mercury. This shows that pressure gradients must be kept low for high permeability cores. Since the allowable pressure gradient varies inversely as the 1.5 power of the permeability, there is little chance of the flow being outside of the viscous range in the case of low or intermediate permeabilities.

Single fluid permeabilities are often measured with air or nitrogen. In such measurements it may be desired to make a "Klinkenberg extrapolation," that is, extrapolate the measurements to infinite mean pressure. This necessitates readings at several values of the mean pressure, usually up to three or four atmospheres. The value of the density in Equation 5 therefore depends on the mean pressure, and for air at room temperature is given by 0.0013 $P_m$, where $P_m$ is in atmospheres. Putting this and the viscosity, 0.0183 cp., into Equation 5, we find for air at room temperature

$$\triangle P \text{ max} = \frac{1.1 \times 10^6\, f^{1.5}\, l}{K^{1.5}\, P_m} \qquad (6)$$

For convenience, a nomograph has been prepared giving values of $\Delta P$ max per unit length of core. Values


$\Delta P = \frac{1100000\ F^{1.5}}{K_{md}^{1.5}\ P_m}$
Nomograph showing pressure gradients above which flow may not be entirely viscous in permeability measurements with air.
$K_{md}$
ΔP
Cm. Water
Cm. Mercury
F
$P_m$ (ATM)

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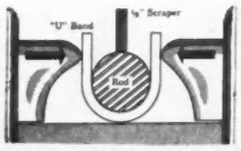


Cross section showing "U" band being die-formed around rod to the scraper blades.

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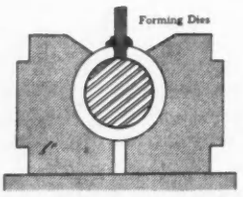


Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade.

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obtained from this nomograph must be multiplied by the length of the core in centimeters.

It is evident that turbulent flow is likely to occur only in the case of high permeability cores, with normal laboratory procedure. When a Klinkenberg extrapolation is made for a high permeability core, an excessive rate of decrease of permeability with mean pressure might be obtained by the use of too high a pressure drop. The nomograph should serve to give an estimate of allowable pressure drops for measurements with air or nitrogen. For measurements with liquids Equation 5 should apply.


### ACKNOWLEDGMENT

The writer is indebted to C. Drew Stahl for the construction of the nomograph.


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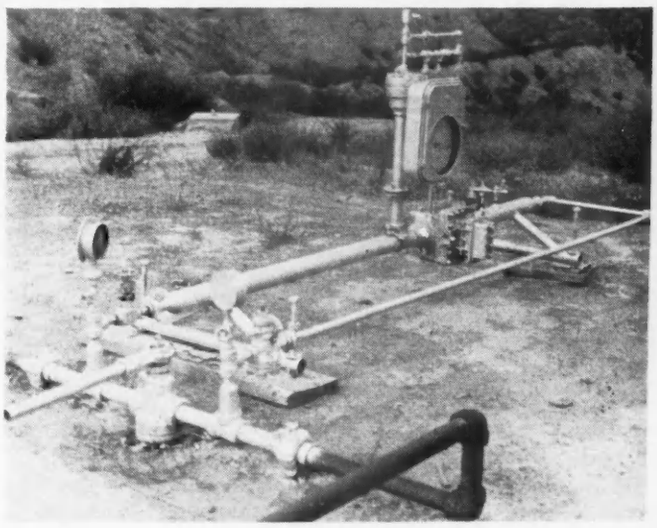
## *About the Author*


DR. RALPH F. NIELSEN received his B.Sc. and Ph.D. degrees in physical chemistry from the University of Nebraska and also studied at the University of Copenhagen, Denmark. He has been employed in the research laboratories of International Combustion Engineering Corporation, U. S. Rubber Company, and Stanolind Oil & Gas Company. He has also been on the chemistry staff of Kansas State College and St. Benedict's College. He is now Associate Professor of Petroleum and Natural Gas Engineering at The Pennsylvania State College, with which he has been associated since 1940.

# How to do it! PRODUCTION HINTS

**$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.**

## HOW TO—Make Unitized, Transportable Meter Run

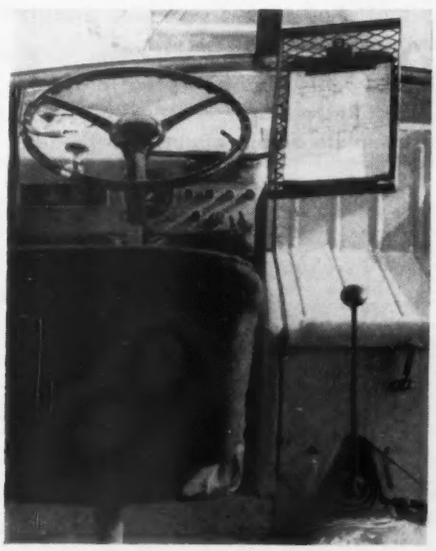


Illustrated is a prefabricated meter run that can be installed in a line when needed, such as when taking gas-oil ratios, or metering gas into a fuel line. This unitized meter run will fit many settings in the field, and can be moved from well to well without too much difficulty. The meter run is normally made of four-inch line permanently installed on leg spreaders that rest on 2 x 12-inch timbers. Jack bolts are inserted in threaded fittings at all four corners with lock nuts for levelling the setting at the location. These bolts are usually about 12 inches long so that wide variations in ground surface can be compensated for when levelling the instrument without the use of excessive cribbing.

The two-inch pipe leading from the source line carrying the gas is attached to the upstream end of the meter run with lug-type ground joint unions so that a pipe wrench is not necessarily required for making up this fitting. The unitized fitting is particularly interesting, since it has standard dimensions which makes connections and installation easy without pipe fitting. The group of fittings is assembled on two-inch pipe, threaded at each end, to be attached without difficulty at a screwed joint. A lubricated plug valve is set in the center as a block valve and flanked on each side with tees, nipples and connections for pressure gauges and threaded couplings for standard ground joint unions, so the entire assembly can be set into any line without difficulty.

The supply line leading the gas from source to the meter run can be placed on either side of the assembly, depending upon the location of the unit, the contour of the ground surface, and the convenience of the crew making the installation. If the door of the recorder faces upstream, the lead line is placed on that side, but if the direction of the gas flow is from the opposite side, then the line can be easily changed by breaking out the ground joint union to place the supply line on the opposite side of the meter run. Lifting eyes are welded to each corner of the meter run so a motor crane, or the boom of a truck, can be used for lifting.

## HOW TO—Convert Route Van Into Pumper's Truck



After a try-out period, it was found that the popular route van makes a suitable truck for the lease pumper where road beds are good. Space in the cargo section of the van is converted into storage for the pumper's tools, gauges, etc. A shallow metal box added at one end of the truck carries a heavy-duty 12-volt battery to be used in starting gas engines driving pumping units. Extra long cables are supplied so the connections may be made with the starter receptacle by backing the van up to the engine.

Opposite the cargo section, a compartment oil tank is permanently attached and contains various lubricating oils necessary for lubricating and greasing the production equipment. A solvent tank is also added. These liquids drain through spigots extending through the side panel of the body at the rear of the fender and above the bumper. Racks installed on each side hold tools and supplies so the pumper may make any repair or adjustment on the spot without making a return trip to the well.

At the right side of the steering wheel is mounted a metal rack in which are carried the pumper's log records. Just below this rack is a metal compartment with a hinged lid. Here are stored rags, both clean and soiled. One of the outstanding advantages of this vehicle for pumper's use is the ease with which the pumper can get in and out of the truck. Wide open doors afford adequate room for the pumper to leave the truck and enter again practically on the run.

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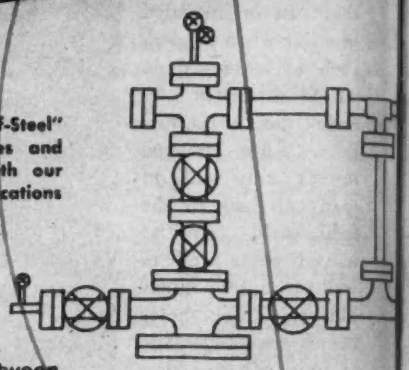

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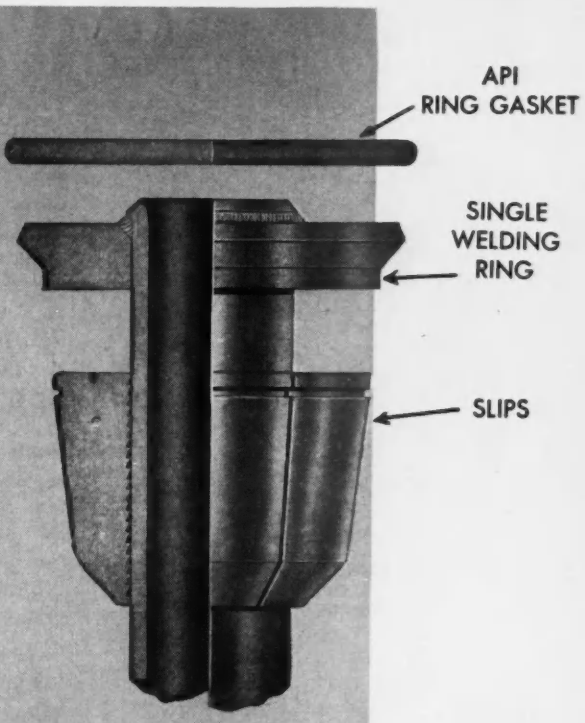


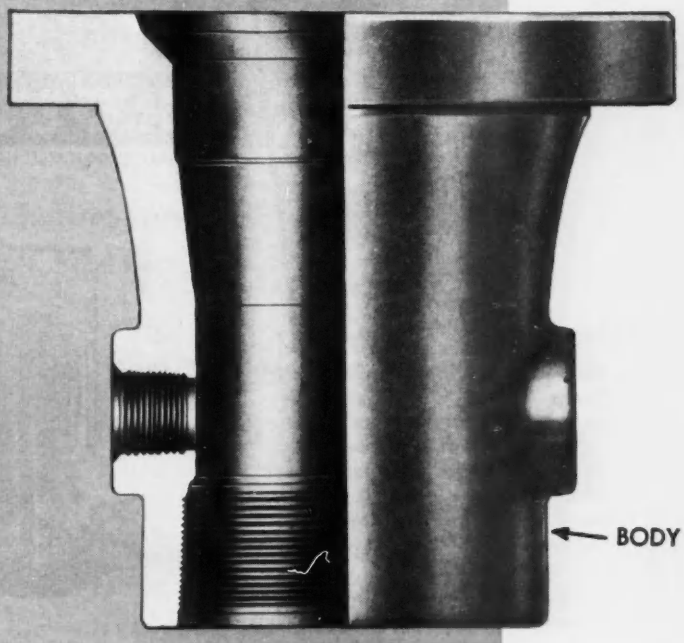


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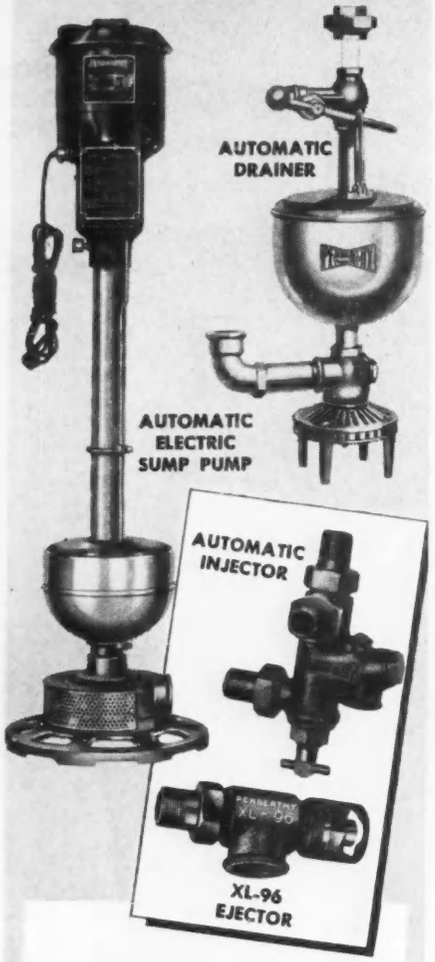


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# HOW TO—Transport Gas Cylinders

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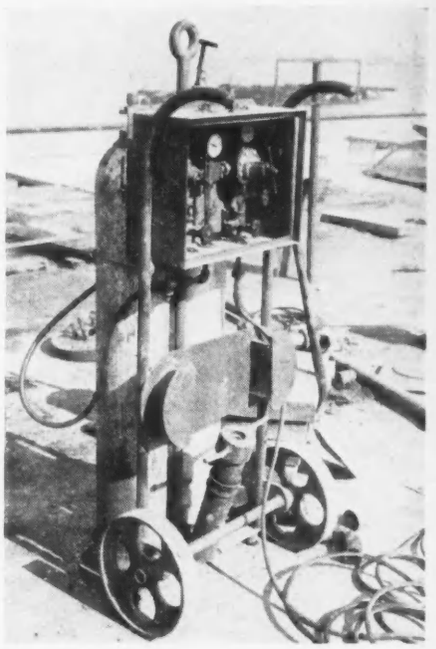
Equipped with a lifting eye, the dolly is hoisted easily to or from the service truck, and is wheeled without difficulty around the well area. On the back of the unit is a small rectangular box in which are mounted regulators, hose fittings and controls. When not in use, the high-pressure hose may be wrapped up on a small rack welded to the back of the dolly. Attached to the axle is a short length of tubing in which is carried a tubing head wire line lubricator. The entire assembly is easily made up, involves relatively small cost, and will pay for itself in convenience and time saved in handling cylinders at well sites.

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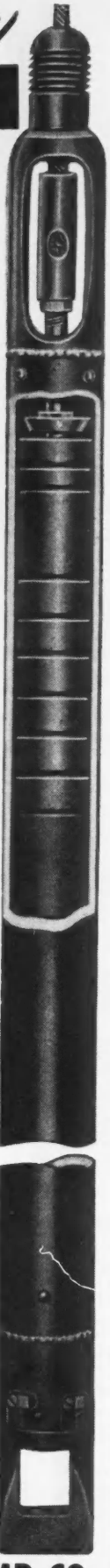

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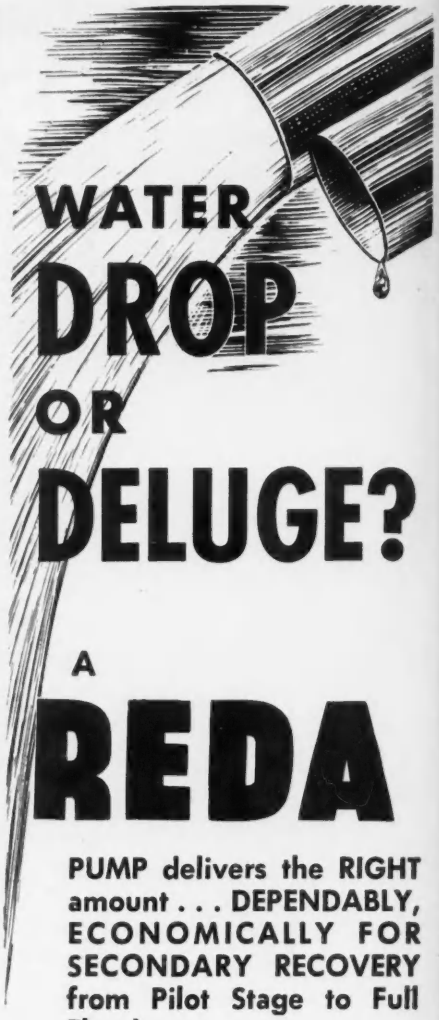
## PRODUCTION HINTS

### HOW TO—
# Safeguard Producing Wells Near Roads

Producing wells located alongside public highways place additional responsibility upon the operator in regard to safety of operations. Not only must some form of road guard be provided, but it must also be designed to permit complete access to the location for well repairs and servicing. Illustrated is an unusual operation involving wells located fairly close together and between a public highway and a sea wall. For additional protection, the wellhead equipment and flow lines were placed in concrete enclosures below the ground level, so that only a clean surface and a well designation sign remains. The problem of blocking traffic into the well sites is solved by installing retractable road guards that can be lowered to make way for the servicing equipment.

The road guard consists of alternate sections of a conventional pipe guard rail and a detachable section of heavy chain. The pipe section is about 15 feet long and is firmly anchored by two vertical supports imbedded in concrete. The vertical rail is welded to the vertical members about 15 inches high off the roadbed. The detachable chain sections, also about 15 feet long, are anchored by welding to one end of the stationary pipe railing. The other end of the chain is fitted with a solid rod welded at right angles to the chain link direction. This rod is placed in a stop on the adjacent stationary pipe railing, and the upper part of the rod is slipped into a slot cut into the top side of the pipe railing. In this fashion, the chain section can be removed when it is necessary to drive in pulling units or wire line equipment. The road guard is sturdy enough to discourage the public from driving over the concrete slab around the well.

# WATER DROP OR DELUGE?

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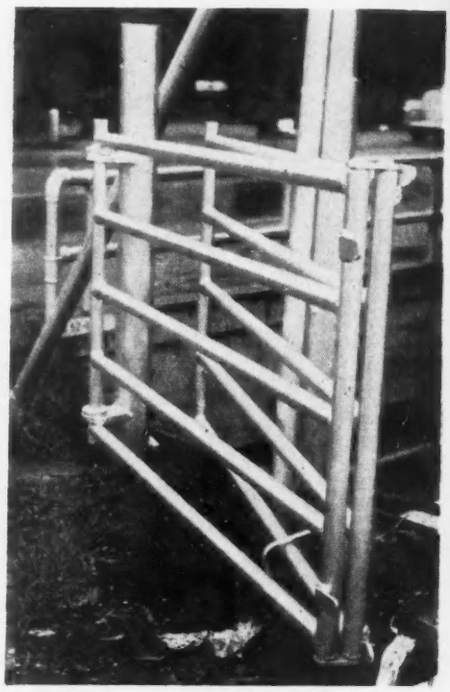
Illustrated is a hinged gate section that is easily folded back against itself in just half the space that would be required for a conventional section. Made of two-inch pipe and of all-welded construction, the gate is amply strong to support its weight without sagging. Stops welded to the two vertical posts where the section folds back on itself prevent the segments from moving beyond the 180 degrees travel necessary to bring that half of the gate into a single straight line. The construction of the gate allows little sag to occur and the main hinge post, which is a length of salvaged casing set in a block of concrete, has welded to it pivot brackets of heavier than usual construction.

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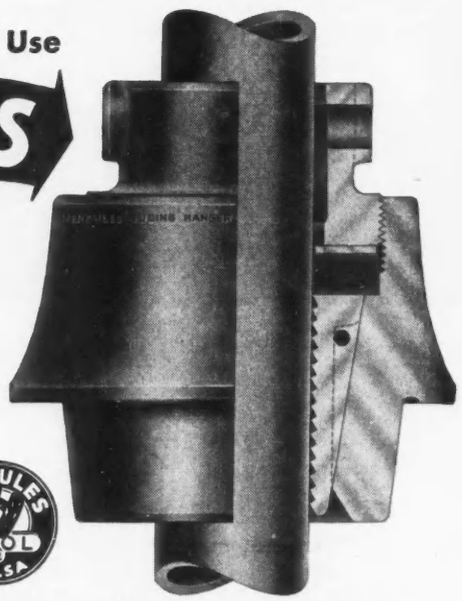

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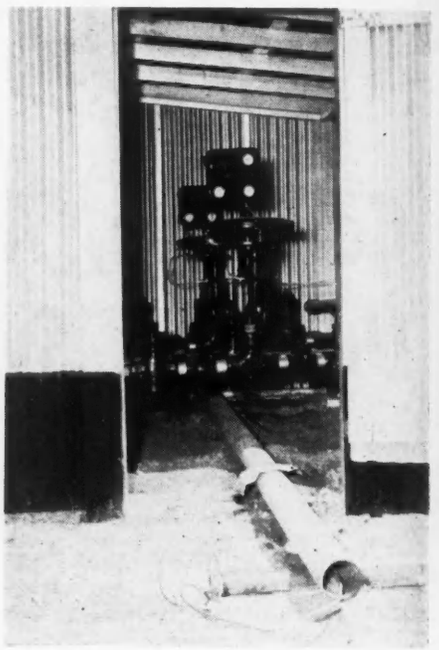
# HOW TO—Prevent Hydrates in High Pressure Lines

High-pressure lines carrying gas with some moisture will form hydrates if the temperature of the gas is brought below the dew-point for that pressure. Such was the case on an emergency completion where a well made gas that had to be choked down in pressure in order that the gas could be handled by the field system and used as fuel gas by nearby drilling rigs. The situation was aggravated by extreme winter conditions, and it was necessary to take measures to remedy the freezing of regulators on the downstream side of the flow restriction.



A small shed made of corrugated galvanized sheet metal nailed to wooden framing was erected around the regulators shown. This shed was made large enough to permit ready access around the equipment for adjustments and inspection. A piece of four-inch pipe extending through the shed and just below the regulator vents on the far side of the shed. A tap from the lease gas system leads up to the shed and a small stop-cock is installed on the one-inch line. A short piece of flexible copper tubing attached to the stop-cock extends inside the four-inch section for several feet.

The flame burns under such gas pressure that heat is carried the entire length of the four-inch pipe. Heat from this section of pipe warms the inside of the shed and prevents hydrates from forming. The line passes through a door leading into the shed. The door was made about one foot short, the opening being left at the bottom so the door could be closed without touching the 4-inch heater line. During summer months, there is no need to operate this heating device, but in severe winter months, it has paid dividends in keeping the gas flowing through the regulators free of hydrate formation.

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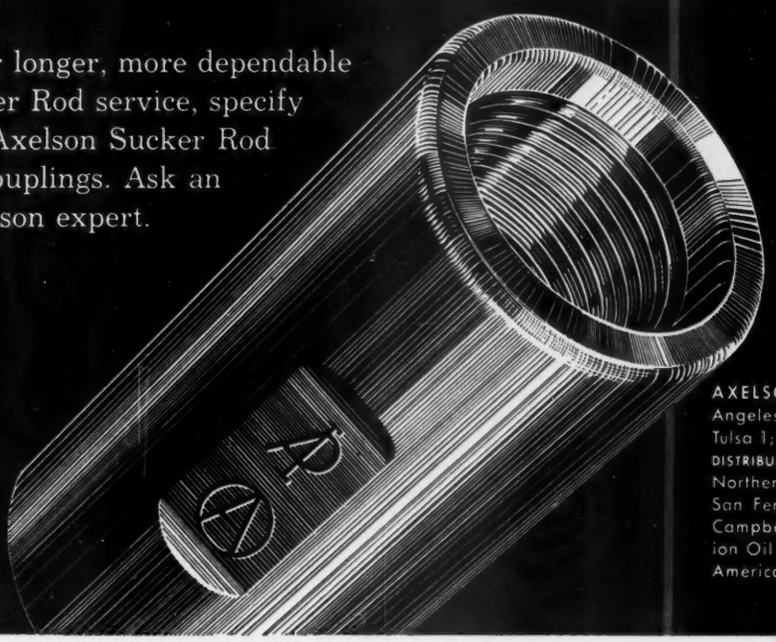

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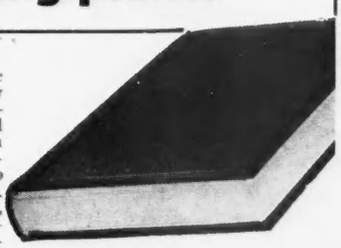

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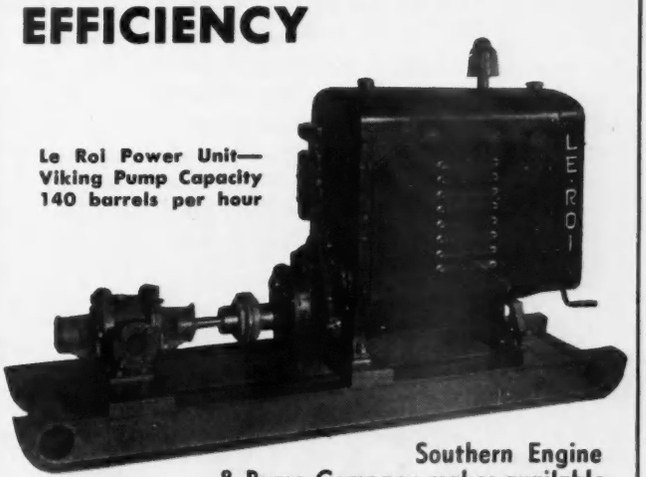


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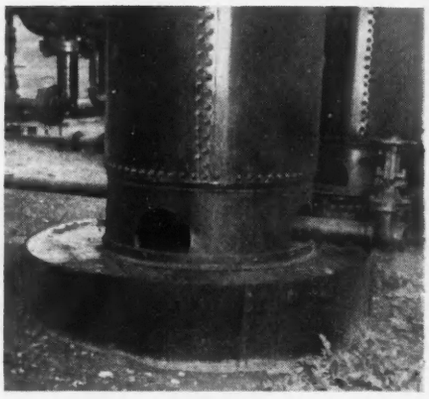
HOW TO—

## Build Inexpensive Bases for Separators

In the placement of production separators, it is important that the base chosen should be not only horizontal, but dry and well drained. One company has found it convenient to use easily-made, circular bases which, with the exception of the gravel used, can be made of salvaged materials.

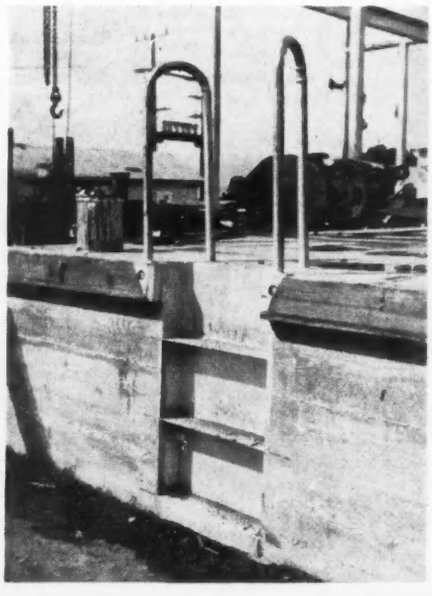
The base consists of a ring approximately 60 inches in diameter that is fabricated out of salvaged tank steel. Width or height of the ring is determined by the conditions, such as the degree of slope of the ground at that point, but in the installation shown, the rings were from 10 to 14 inches high. Gravel is placed inside the ring and on top of it is laid one side of a dismantled wire line spool. This type of base is easily and quickly installed in the field, and the components, with the exception of the gravel, can easily be stored in the warehouse for use when needed.

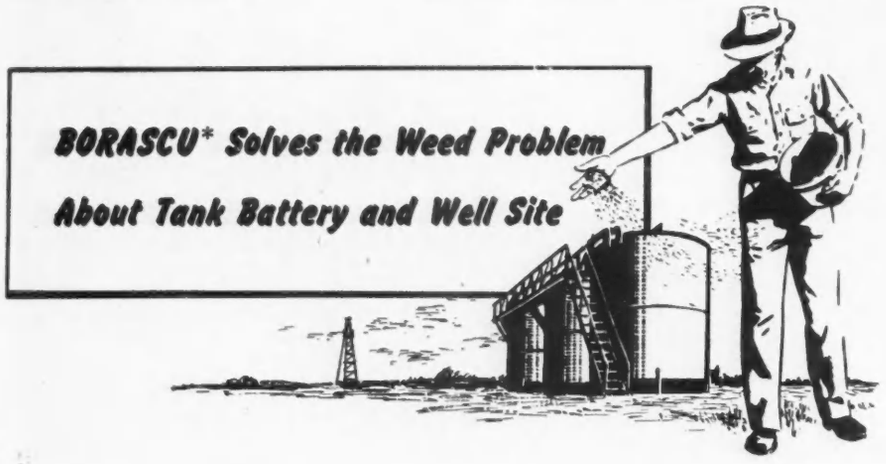


HOW TO—

## Add Flush-Mounted Loading Dock Ladder

A method of saving valuable yard and dock space, as well as providing a maximum clearance between the dock and roadway, may be incorporated into the plans when a concrete dock is to be built. Instead of making a large stairway on the loading end of the dock that either cuts some distance back into the platform, or projects into the roadway, a three-step, flush-type ladder similar to that shown is constructed. In this installation, the non-skid surfaced steel steps are approximately 6½ inches wide by 28 inches long, the ends of the steps projecting several inches into the concrete on either side. Equipped with a pair of easily grasped hand rails, this simple ladder serves well when a man must climb up to the dock or get down or when it is inconvenient to step on to the dock from the truck bed.

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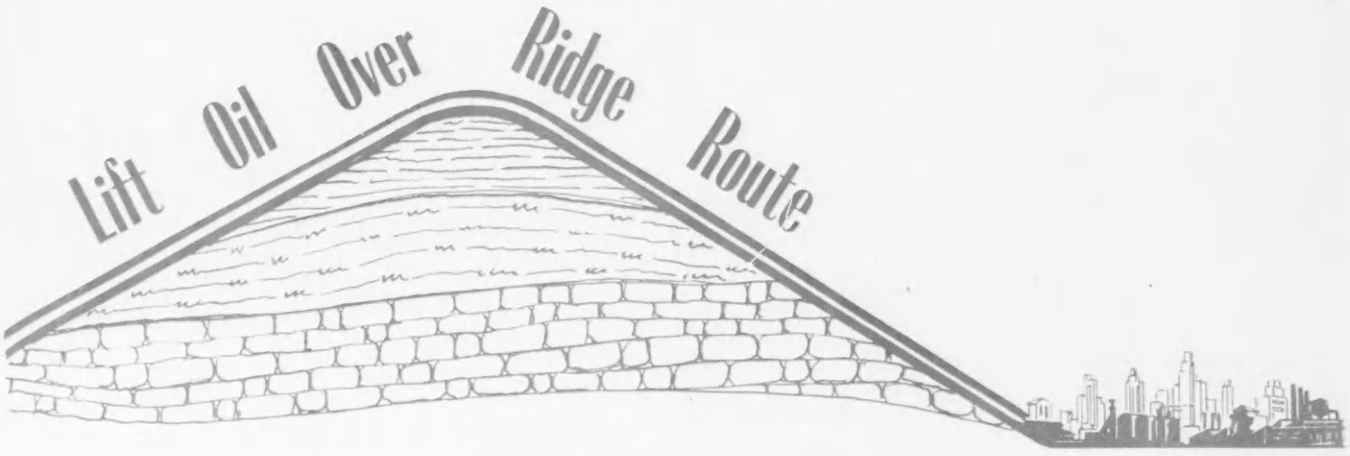
# Diesel Stations

## Lift Oil Over Ridge Route



By JAMES JOSEPH

**RICHFIELD'S two new pump stations that handle 75,000 barrels of crude oil per day are designed for maximum fuel and heat economy and minimum operating costs. The stations are models for their type and are engineered for the kind of pipe line efficiency which pipe line men like to brag about.**

THE push that sends 75,000 barrels of crude daily surging through Richfield Oil Corporation's new 14-inch, 112-mile long pipe line from the Kettleman and Cuyama fields to the company's refinery at Los Angeles harbor is supplied by two diesel-pumping stations. The stations are models for their type and are engineered for the kind of pipe line efficiency which pipe line men like to brag about.

Each of the new pump stations, one at Wheeler Ridge, elevation 790 feet, the other at Tejon, elevation 3075 feet, are installed with three 7-cylinder, 13- x 16½-inch dual-fueled engines which operate either on crude taken from the line or on natural gas from a Southern California Gas Company trunk line which runs near the Richfield sites. Each of the engines, which are rated 1,050 horsepower and are super-charged, work through an 8:1 ratio speed increaser coupled to a 3600 revolutions per minute centrifugal pump. Two engines, driving the 37,500 barrels per day capacity pumps at 1000 pounds per square inch handle the crude in parallel for a total pump-house capacity of 75,000 barrels per day. One diesel engine is for standby.

There were two good reasons for Richfield's $7 million investment: increased civilian demand for petroleum products in the west and accelerated demand by the armed forces. To supply these, the oil company rushed the line and its two pumping stations to completion, and had them finished by February 1.

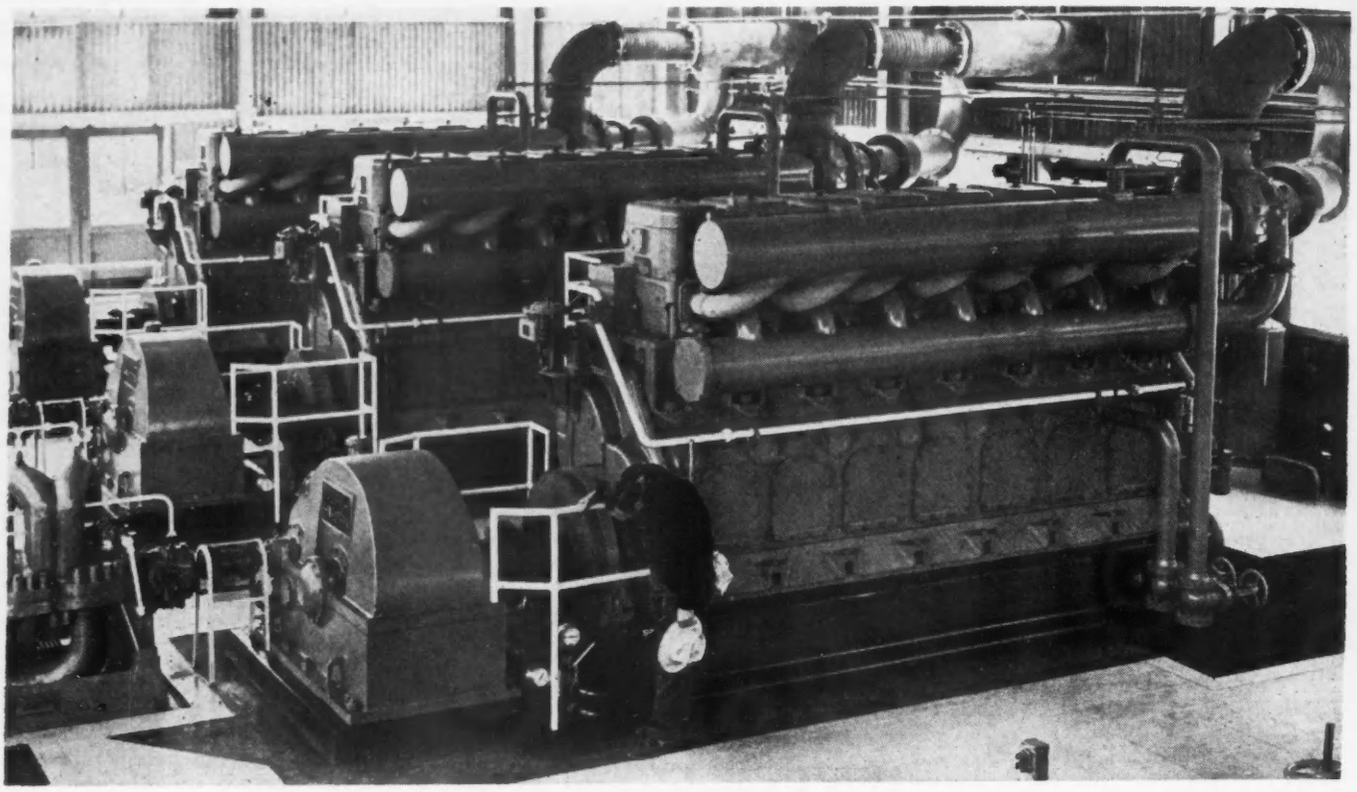
The new stations supplement—although work independently—five pumping facilities already built and operating along an existing ten-inch line built in 1925.

Both new stations are identical. Each has the three engines; each has adjacent tanks for crude storage; and each maximizes the use of engine cooling water to a remarkable degree. The Wheeler station has three storage tanks, two of them 37,500 barrels capacity, and another 54,000 barrels. At Tejon there's a smaller tank farm, with two, 37,500-barrel storage units. Between the two stations, the 14-inch line becomes a 16-incher because of hydraulic design techniques. The 14-inch outside diameter line which was both electric welded and seamless in sections, has a wall thickness varying from one-fourth to three-eighths-inch. The 16-incher's wall varies from nine-thirthy-seconds to three-eighths-inch.

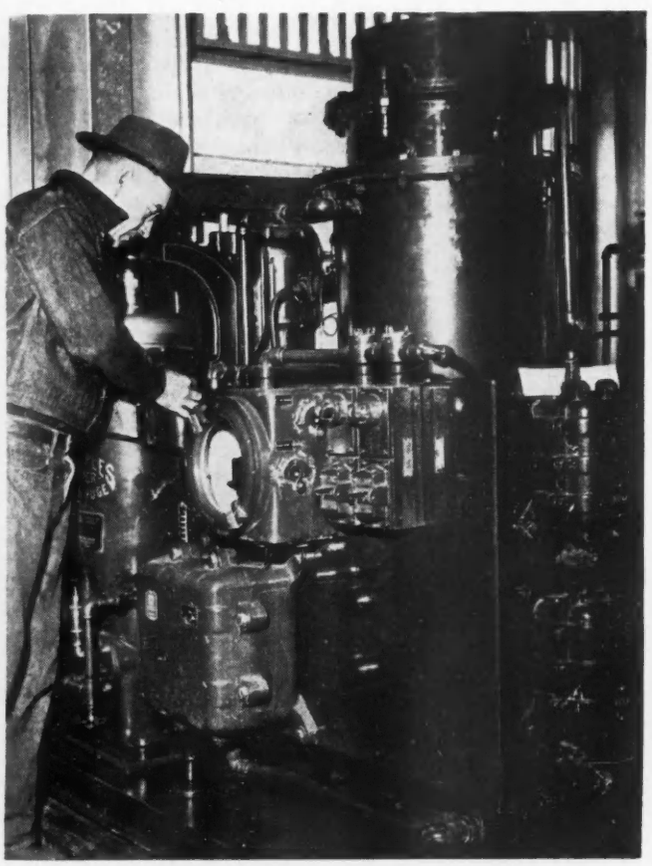
Diesels in each station are automatically controlled from a central panel. This control station gauges the discharge pressure of the line; the pressure into the pumps; the discharge flow into the line; and there's a pyrometer, telling the operating engineer the temperature of the oil in the discharge end of the line—toward Los Angeles. An engine control selector switch allows the control room operator to set the amount of crude flowing through the line. There are also gauges telling the discharge pressure of each of the three pumps and remote tachometers reporting the actual rpms of each engine, ranging from 0 to 800 rpm, with the average operating rpm between 400 and 450.

The dual-fuel features of the diesels were especially advantageous for Richfield since it had the crude right at the site. Although the stations have just begun operation, Richfield engineers plan to run the diesels 10 percent on crude and about 90 percent on natural gas—for a considerable fuel savings. Richfield's old stations on the Ridge Route, each of which has two air-injection diesel engines, rated at 300 hp, or 600 hp per station, run 100 percent on crude. The diesels at these stations power reciprocating pumps.

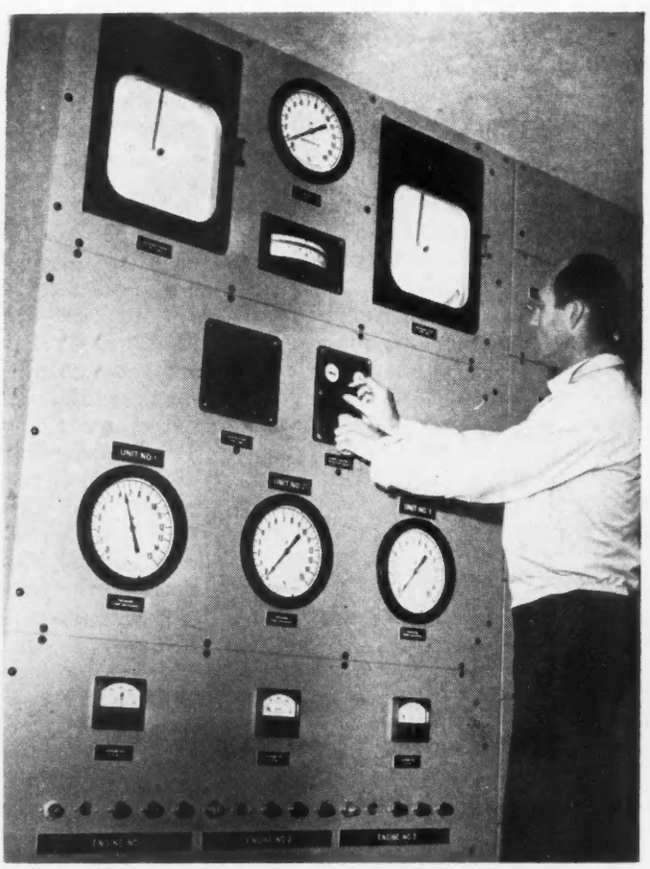
Crude for fuel is tapped from the main trunk at the new stations and is run through a 15,000 rpm, centrifuge to remove impurities. The crude to fuel oil centrifuge has a 500-gallon per hour capacity. After cleaning, the fuel oil is pumped into one of two 3000-gallon storage tanks located outside the plant. A second centrifuge removes impurities from the lube oil, from where it flows into



Three engines in interior of pumping station.



George Watson, chief operating engineer, works at centrifuge which cleans impurities from crude to make it useable for engine fuel oil.



Charles B. Miller adjusts engine control selector valve on main control panel, which is heart of pumping station.

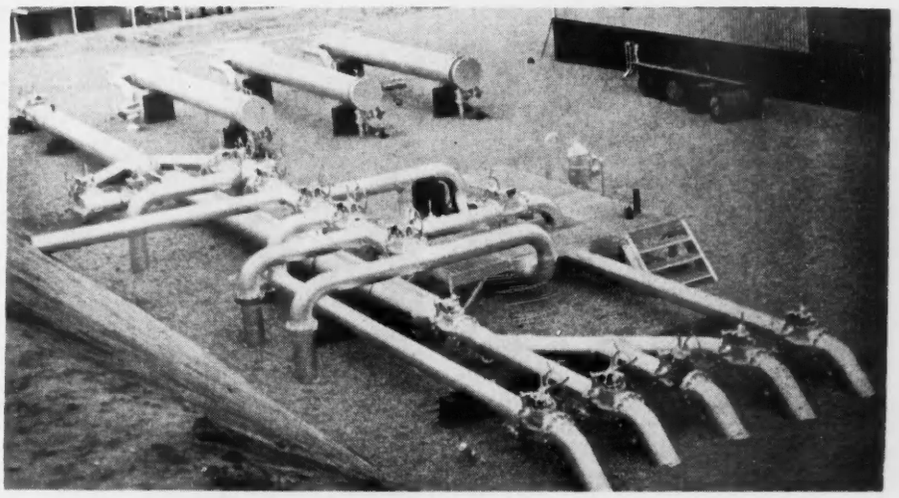
a storage tank and is later pumped into a 265-gallon day tank. The centrifuges have sufficient capacity to clean and store enough fuel oil to run the plants in case of a total gas-shutoff. In case of gas failure, the engines go automatically onto crude.

Probably the most interesting feature of the Richfield pumping stations is the extensive use of engine cooling water to both cool and heat various liquid components of the system in a maximum-engineered heat-exchanger setup. Heat-exchangers are used in the process for jacket water cooling, on engine lube oil cooling, for gear oil, as fuel oil heaters, and even to warm the crude in the pipe line.

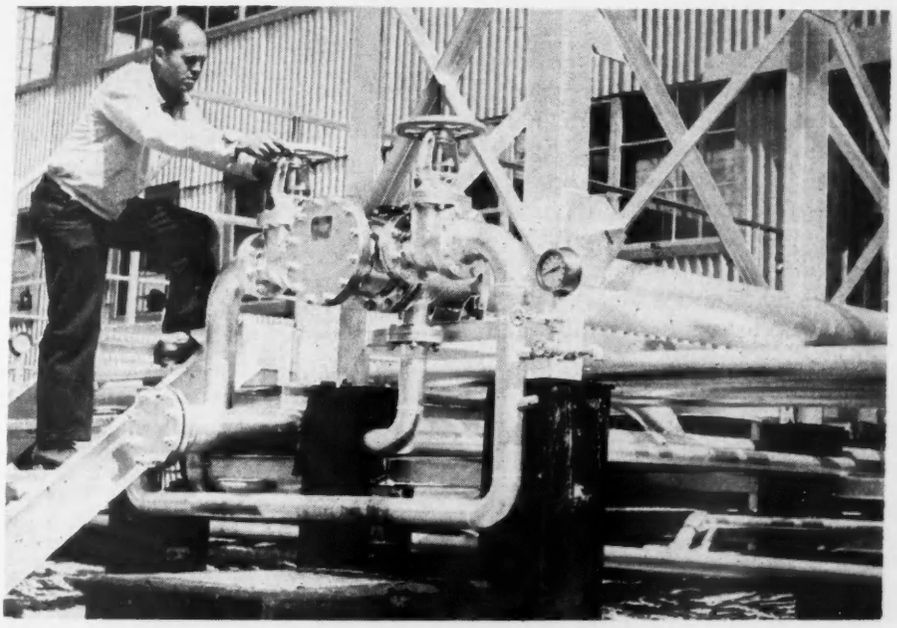
Here's how it works: Engine jacket water at 160° F and 380 gallons per minute is forced into a surge tank. From the surge tank the jacket water goes to a jacket water pump (one for each diesel engine). These pumps are driven by a 15-hp electric motor. At the jacket water pumps, the engine water is split and bypassed in about a 70:30 ratio. Seventy percent flows back to a common point through a fixed bypass to the engine. At the split, 263 gpm (the 70 percent) at 160° F flows back to the engine, but is routed through heaters warming the diesel fuel oil. That is one heat exchanging operation. Meanwhile, 117 gpm (the 30 percent) at 160° F, flows to one of three jacket water coolers. These coolers are manifolded interchangeably with the jacket water pumps.

Oil from the main pipe line or from the storage tanks—depending on the setting of the manifolding system—is split in half and passes through the tube side of the jacket water heat exchangers to the suction side of the pumps, and emerges about 10.3° F warmer. This makes the crude more viscous, and thus it flows more easily and with less friction through the main pipe line. Meanwhile, in this heat-exchange, the engine cooling water has been lowered in temperature from its original out-of-the-engine 160° F to 118° F, a drop of 42 degrees. The engine cooling water now flows through a gear oil cooler (cooling gear oil) located inside the pump building. In this exchange, the engine cooling water picks up about .5° F so that it leaves the gear oil cooling jacket at 118.5° F, while the gear oil loses ten degrees in the process. Gear oil which had entered the cooling jacket at 25 gpm at 135° F, emerges cooled to 125° F.

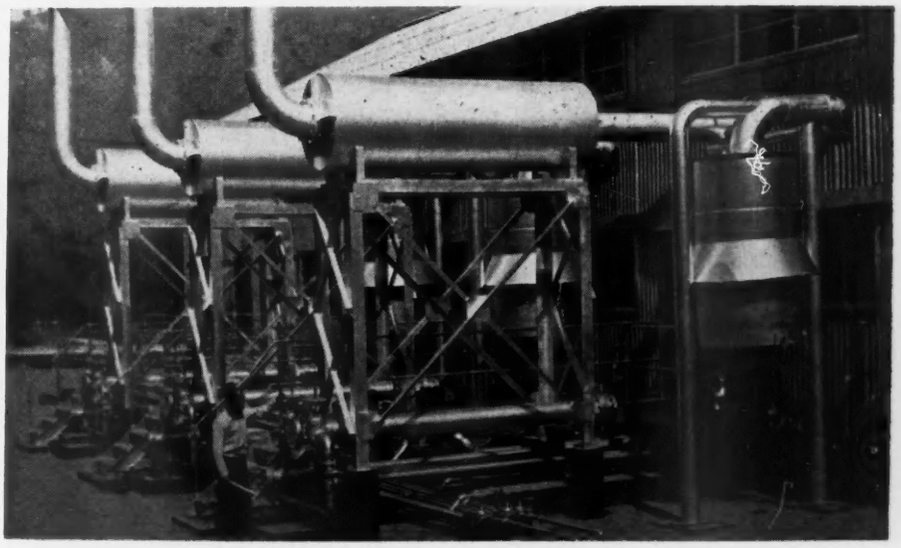
The engine cooling water still has



**Manifolding system which receives oil from both Cuyama and Kettleman fields at Wheeler Ridge station. Jacket water coolers in background.**



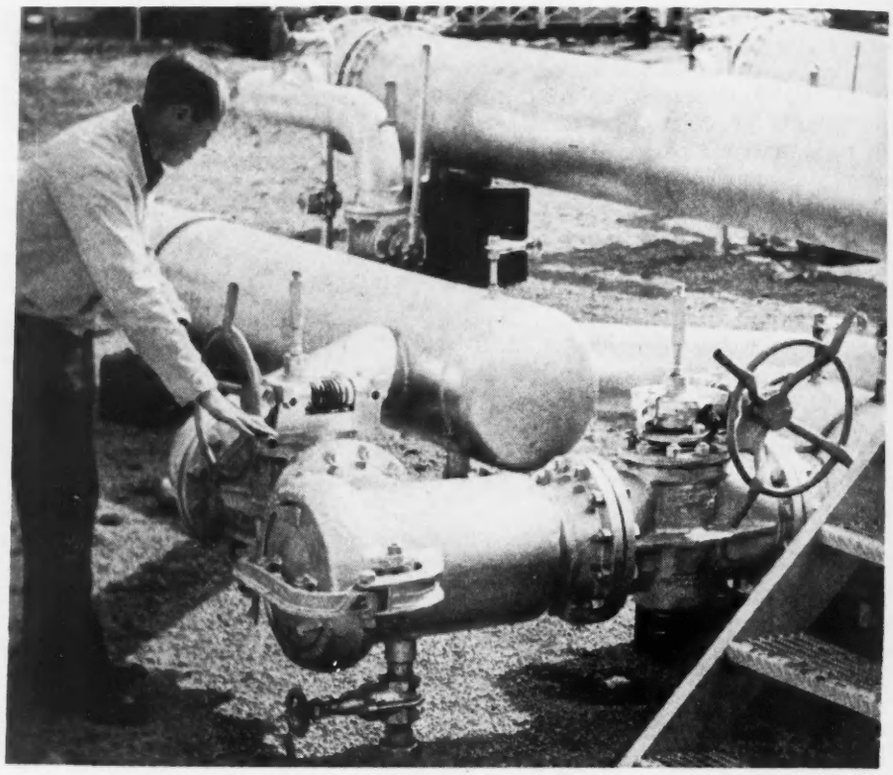
**Valving engine lube oil cooling jacket piping.**



**Silencers and air filters at Tejon station.**

not completed its circuit. Leaving the gear lube cooler at 118.5° F and at 117 gpm, it next enters an engine lube oil cooler, where it picks up about 7.3° F, rising to a temperature of about 125.8° F. At this point, its multijobs are about finished and it is ready to enter the engine once again. The trouble is, 125.8° F is too cold for the engines, so this is where the 117 gpm stream meets the bypassed 263 gpm (the shunted 70 percent) cooling water. Since this bypassed water is at 160° F, it mixes its much larger volume with the smaller incoming volume of the cool engine water, and re-enters the engines at 150° F—or just about ten degrees cooler than when it left the engine for its long and beneficial heat-exchanging route. All of which makes Richfield's new pumping stations' heat-exchanging system about as efficient as any in the industry.

Manifolding systems at both stations are likewise well designed. A ten-inch line runs to both storage tanks at the Tejon station, tapped off the incoming 16-inch line from the Wheeler station. Before crude enters the pumping stations, either from main line or from storage tanks, it's put through filter (strainer) valves to clean it up before it enters the pumps and cooling jackets.



**Manifolding at Tejon station. Miller works valves at strainer valve. Pipe in foreground is 16-incher from Wheeler Ridge station.**

Another innovation is jacket water controllers—which automatically monitor the temperature at the jacket water coolers. This control is accomplished by an automatic three-way valve which bypasses engine cooling water away from the jacket if the outgoing water is too hot, or allows greater quantities to flow through if the discharge water is too cool. The aim at all times is a discharge temperature of 118° F.

There are governors on each diesel engine. These are controlled by air-actuated valve positioners which get their air pressure from a metering system located in the main crude line and which are controlled by the flow of crude. While the actual amount of flow through the stations—and thus through the main crude line—is regulated from the control room, this governor automatically speeds up or slows down the diesels through a 10 percent variance from the set position according to the amount of flow through the main line. If more than the 10 percent variation is desired or demanded, the flow control through the pipe must be set at the control room. In effect, the governor—actuated by linkage and pneumatic transmission from a remotely located flow regulator in the main pipe—gears the diesels and their pumps to the demands of the line.

The complete installation of pipe line and pump stations was completed under direction of Jack Lynch, special project engineer of Richfield's Pipe Line department, of which N. F. Anderson is manager.

**Frank Griffith, operating engineer, at jacket water pumps in Tejon pumping station.**

In Republic Electric Weld Line Pipe, *uniformly round ends* match perfectly.

*Uniform diameter* speeds joint welding.

*Uniform wall thickness* means dependability in every inch.

*Uniform high yield strength* permits building of higher pressure lines.

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High ductility steel simplifies *field bending.*

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*Freedom from scale* protects against clogged valves.

*Long lengths* reduce number of joints.

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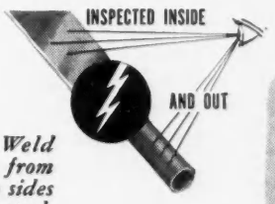


*Republic Electric Weld Line Pipe is made from flat-rolled steel, both sides of which are inspected. Thus, the surface which becomes the inside wall is free from hidden defects.*

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**ELECTRIC WELD LINE PIPE**

REPUBLIC STEEL

**Other Republic Products include Casing and Tubing—Carbon, Alloy and Stainless Steels—Studs, Bolts and Nuts—Heat Exchanger Tubes**

**ACCURATE, REMOTE tank gauging is now possible through use of float actuated transmitters tied electrically to a common station gauge board located in an office. The only labor involved is turning a selector switch to the tank number being gauged, and pushing a registration button which lights up a calibrated gauge screen.**

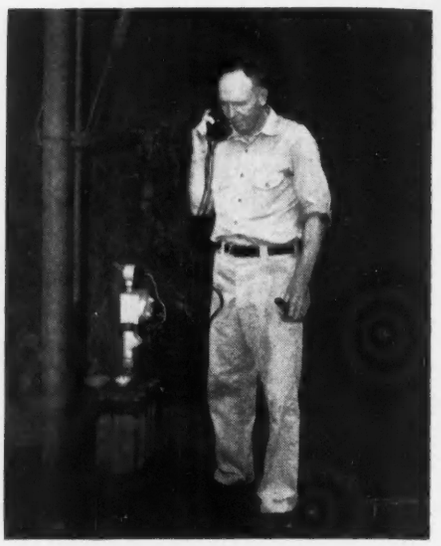


**FIGURE 1 (left). Operating engineer demonstrates ease of push-button gauging. He has dialed a tank, pushed the registration button, and gets the reading on illuminated screen.**

**FIGURE 2 (right). Individual tank epuipped with transmitter box, plug-in phone, and upright housing for gauging tape and cables.**

# Push Button Tank Gauging

IN KEEPING with its modernization program, Cities Service Pipe Line Company has discarded the old-fashioned hand line at its Cimarron Pump Station and has installed push button tank gauging with a telematic liquid level indicator in the station office. Tank gauging no longer involves manually lowering a tape line into the tank, but is done without effort in a matter of seconds.

In recent years pipe line volumes and rates of flow have increased to where oil in 155,000-barrel tanks can be transferred at the rate of one-fifth inch per minute, making time consumed by manual gauging an important factor in the accumulation of data for inventories and oil movements.

In Figure 1 the operating engineer at the Cimarron station demonstrates the ease of modern-day push button tank gauging. After having selected a tank to be gauged and pushed the registration button, he is able to read on the illuminated screen the exact level of oil in the tank selected. With the gauge noted, he is ready to dial another tank and check gauges there. It is also possible to obtain a continuous gauge on any tank being filled or drained. This form of push-button tank gauging is accomplished through use of a float-actuated transmitter at each tank, connected to an underground cable which terminates at the receiver in the station office.

### Mechanical Phase

The mechanical phase of push-button tank gauging at each tank is shown in Figure 2. The upright houses the gauging tape and cables that register here at the transmitter box at all times. These measurements register on the station board only when the tank has been dialed into the board. A constant gauge on a tank being filled or drained can be read here at the transmitter box or in the station. A voice-powered field telephone can be plugged in at any of the tanks for communication with operators at the station.

The system installed at the Cimarron station employs the step-by-step contactor principle operating at 30 volts d.c. maximum at one ampere. Standard aerial or underground telephone cable may be used as transmission line. The system is fully approved for use in hazardous locations and material and components have been designed to withstand corrosion and atmospheric conditions associated with highly corrosive crude oils. The installation on cone roof type tanks was accomplished without taking the tanks out of service. The use of conventional telephone cable for transmission line permits the use of sound-powered phones (Figure 2) for communication throughout the tank farm. This has proved a valuable asset to tank farm maintenance or construction men as well as normal operating personnel.

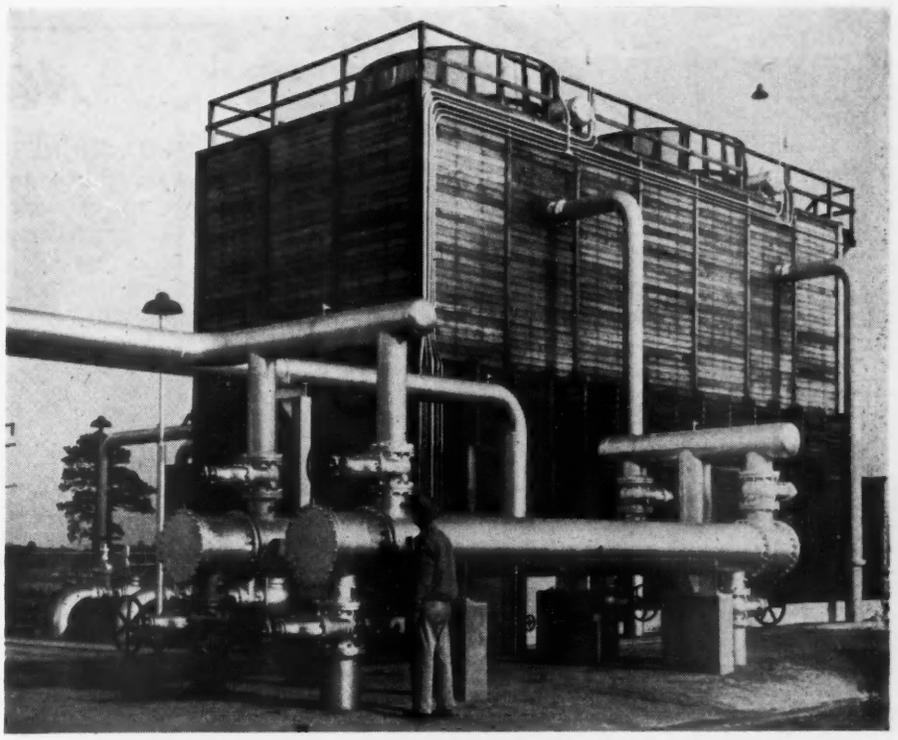
The company's operating department reports push-button gauging has resulted in considerable savings in labor. Present gaugers have several hours time on each shift to perform maintenace work which would otherwise require hiring of additional labor. Another convenience which is also an important safety factor is elimination of the hazard of climbing tanks each hour; the system also assures year-round operation regardless of weather conditions.

Push-button tank gauging at the Cimarron station means no more ordeals of battling the rain, sleet or snow. No more missed gauges during electrical storms. No more late or off-time gauges to harass the dispatcher.

# COOLING TOWER SPRAY WATER COOLS LUBE OIL

By R. D. RICKETTS
Vice President
Fish Engineering Company

**USING GAS COOLING tower spray water as a cooling medium for controlling compressor engine lube oil is novel in gas transportation. However, similar installations have been used for some years in other industries. Such systems offer efficient, accurate temperature control at low operating costs.**



Spray water flowing through the tubes of these shell and tube heat exchangers transfers heat from the closed system lube oil cooling water.

SPRAY water from the gas cooling tower is used to cool compressor engine lube oil in some of Transcontinental Gas Pipe Line Company's compressor stations. This spray water absorbs heat from a closed cooling water system, which in turn transfers heat from the engine lube oil.

This system, shown in Figure 1, has efficiently controlled lube oil temperatures within a narrow range during seven months of operation despite wide variations in ambient temperatures. At the same time, it has virtually eliminated any possible shutdown of compressors due to failure of the lube oil cooling process.

Although novel to the gas industry, this lube oil cooling system is not new. Fish Engineering Corporation, designer and constructor of the Transcontinental system, adapted this design from successful industrial practices in order to meet stringent operating conditions of Transcontinental's Plan I program.

This program called for Transcontinental to begin operating its Texas-New York system by delivering 340,000 Mcf, or 60 percent of ultimate gas sales capacity per day, with only one-third of the compressor stations operating. Obviously, all compressor engines would be required to operate continuously for long periods of time, and all equipment tied in with engine operation would have to operate a maximum time at peak efficiency. Hence, a lube oil system affording maximum dependability had to be selected.

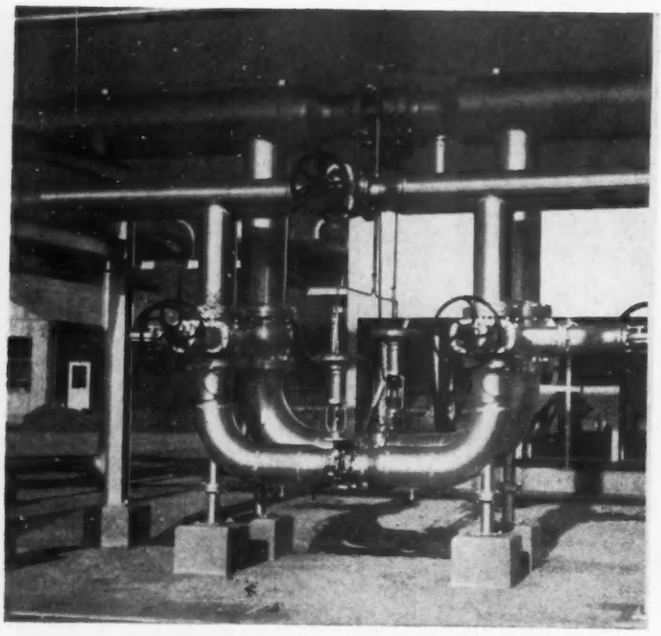
A second factor governing the selection of this cooling system was initial expense and operating cost. The installation of heat exchangers and additional piping proved less costly than an additional cooling tower bay with cooling coil sections or an additional atmospheric cooler. Operating costs for this type installation have been negligible.

An individual shell and tube lube oil cooler for each of the 1600 horsepower or 2400 horsepower engines installed in the Plan I program is located in the main compressor building basement at the side of the engine foundation. These coolers are sized to provide 145° F oil inlet temperature to the engine and 150° F outlet temperature as specified by the engine manufacturer. Of course, this lube oil flows through the shell side of these coolers countercurrent to cooling water flowing through the tubes of the cooler. Valves on the lube oil lines enable operators to bypass these coolers when necessary.

A separate closed circulating water system supplies cooling water to lube oil coolers through supply and return headers in the compressor building basement. This system provides for the circulation of 2057 gallons per minute of 110° F water to the lube oil coolers and 118° F water from the coolers. Water returning from these coolers flows into an individual surge tank. From the surge tank the 118° F water is picked up by one of two electric-motor driven centrifugal pumps in the auxiliary building. Ordinarily, only one of these pumps is in operation and the other is serving as a standby. The water is then pumped through the shell side of one of the heat exchangers near the gas cooling

tower. Here the water is cooled from 118° F to 110° F. A temperature recording controller with a bulb downstream from this exchanger actuates a control valve which allows enough water to bypass the exchanger to insure that cooling water supply entering the lube oil coolers remains at a constant temperature of 110° F.

Gas cooling tower spray water flows through the tube side of these exchangers countercurrent to the closed system cooling water in the shell side. This spray water is picked up by spray pumps from the gas cooling tower basin, and pumped at the rate of 3230 gallons per minute through the exchanger tubes and thence to the spray nozzles at the top of the tower. When this water is picked up in the tower basin after it has passed over the gas cooling coil section, its temperature is usually about 109° F. After exchanging heat with the closed system cooling water, the temperature is raised to about 114° F.

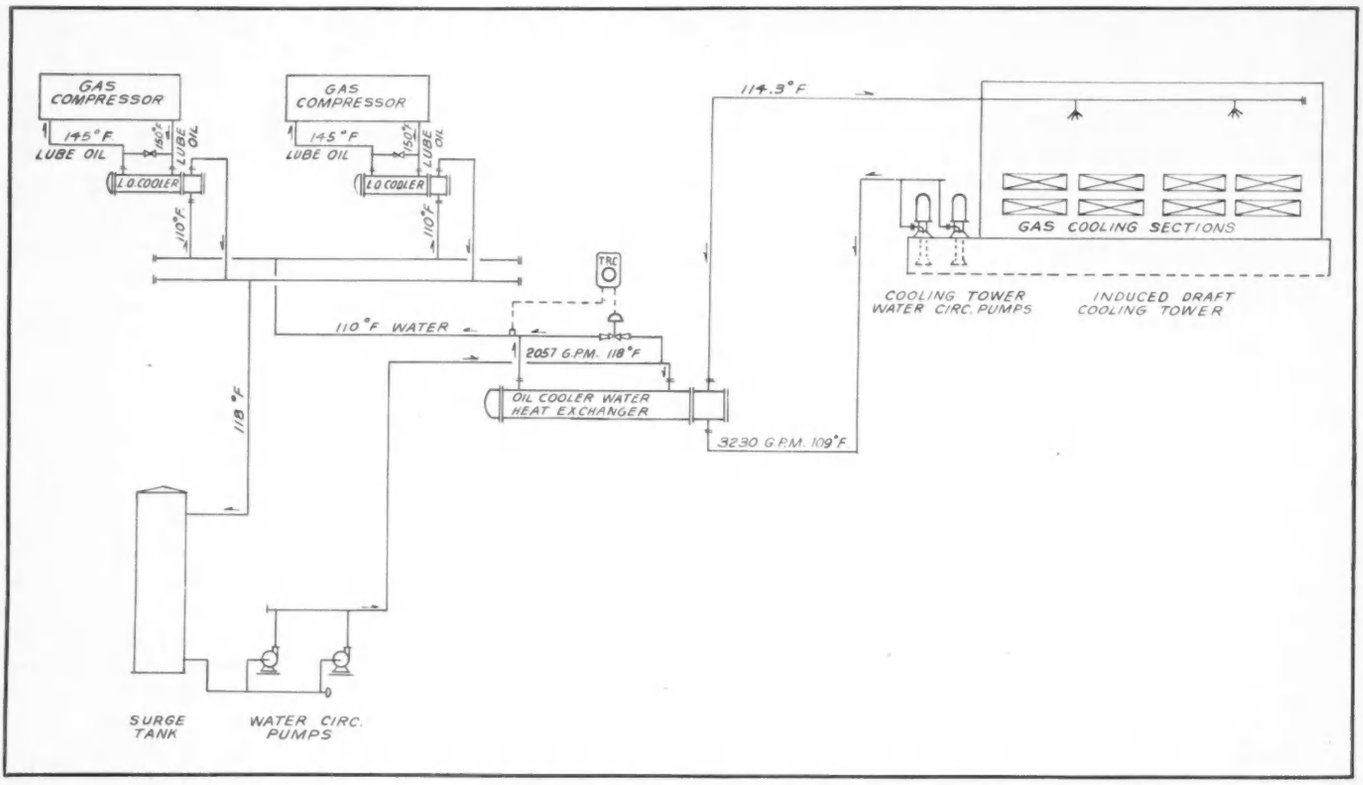


**Temperature control valve maintains constant 110° F. lube oil cooling water by permitting part of water to bypass the exchangers.**

## About the Author

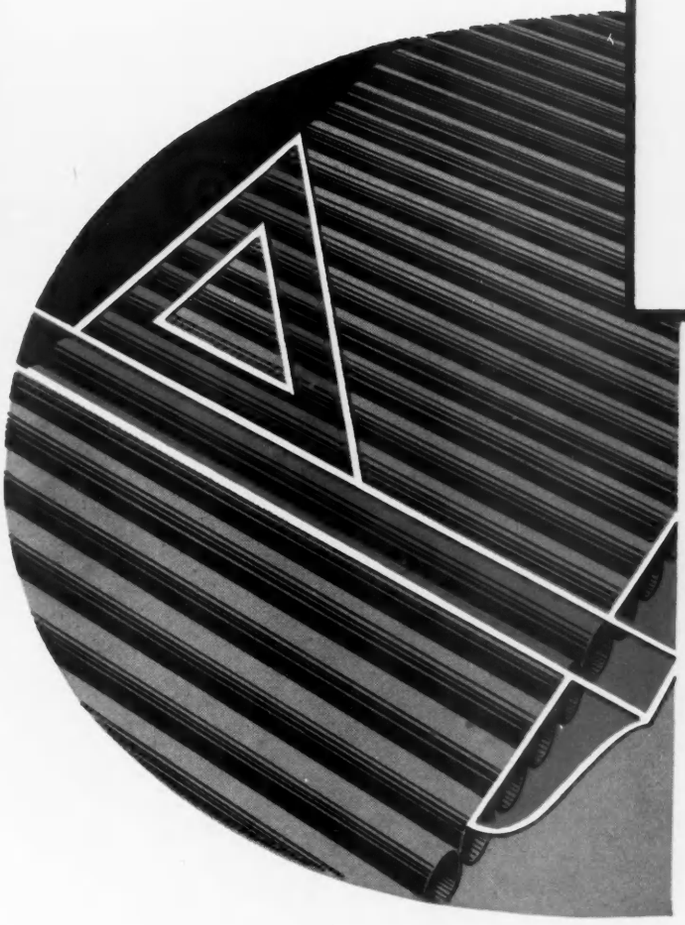
R. D. RICKETTS, vice president of Fish Engineering Corporation and Fish Constructors Inc., is in direct charge of work being done by Fish Constructors on the engineering and construction of the Transcontinental Gas Pipe Line system. Ricketts is a graduate of Ohio State University Engineering School and is a registered professional engineer in Ohio and Texas.

Prior to 1946, when he and his associates formed Fish Engineering Corporation, he was with Stearns-Roger Manufacturing Corporation, supervising engineering and construction of all types petroleum and gas processing plants as well as compressor stations. After graduating from Ohio State, he worked nine years for Columbia Gas and Electric System, gaining design, engineering, and maintenance experience in pipe line, compressor station, and gasoline plants. He had additional experience with Panhandle Eastern Pipe Line Corporation, participating in this company's expansion during 1936 and 1937.




**Flow diagram of lube oil cooling water**

# Why the *FIRST* names in pipelines depend on the *FIRST** name in line pipe



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Here's what this means: line pipe is stressed beyond its yield point by uniform internal expansion—a process that produces higher yield strength. The result is line pipe that is lighter and stronger . . . yet requires no expensive alloy steel to obtain these desirable characteristics. It all adds up to a better line pipe that is simple and economical to weld—permits higher operating pressures—lower cost per mile.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝ in. to 36 in. in diameter.

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# Oil Barge for River Service

A TWO-BARGE, high-speed integrated fleet with a total capacity of 51,000 barrels of oil was recently placed in service on the inland rivers by Texas Barge Line, Incorporated, of Houston. Measuring 290 feet by 50 feet and of all-welded construction, each barge was built with one square end which butts against the square end of the second barge to form a single unit 580 feet long. The rake end of the leading unit was specifically designed for single width, high-speed towing, and therefore has considerably more than average forming. The trailing unit has a deep transom stern rake.

A high-capacity, diesel-driven deep-well pump was mounted at the square end of each barge. Two 7500-gallon capacity rectangular tanks were installed on the centerline of each barge's deck to provide additional towboat fuel oil storage.

Each barge has ten cargo compartments and is equipped with under-deck cargo piping, consisting of a ten-inch cargo header with eight-inch and six-inch branch piping. A sea chest connected to the pump is provided for ballasting and flushing out the barge.

All cargo compartments are equipped with steam heating coils. Steam supplied to these coils from a shore connection will be used to heat the heavier grades of fuel oil and thereby facilitate pumping of that type cargo.

A centerline, retractable skeg is installed on the deep transom stern rake of the trailing unit. The skeg is normally lowered into operating position to reduce yaw or slideslipping when the barges are being towed on a line behind a tug. For river push towing, the skeg is raised into a protective housing by a hand winch located on the deck. The barges were designed and constructed by Dravo Corporation, Pittsburgh.

**Looking down on the deck of one of the barges indicates its size. Each unitis 290 feet long by 50 feet wide. Cargo is carried in ten tanks. Cargo piping is below deck. A diesel-driven cargo pump is located on the after end of each barge.**

# Ventilation System

## Lessens $H_2S$ Vapor Hazard

By HOLLEY P. BRADLEY

Supervisor of Safety, Service Pipe Line Company, Tulsa

**HAZARDS OF handling sour crudes lie largely in the poisonous fumes of hydrogen sulfide which are liberated. Heavier than air, these fumes tend to collect in low or confined areas, and although readily recognizable by their odor on first encountering them, they lose their warning on continued contact, and can cause asphyxiation. The author describes a system for ventilating a station building in which advantage is taken of gravity separation of the $H_2S$ from air.**

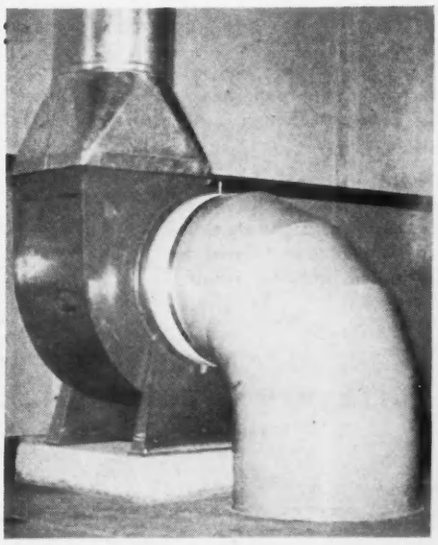
WHILE all crude oil vapors present hazards of asphyxiation, fires and explosions, hydrogen sulfide ($H_2S$) vapors produced by sour crudes are probably the most insidious and lethal. Hydrogen sulfide gas is heavier than air (specific gravity 1.1898) and can first be detected by the characteristic smell of "rotten eggs." It is colorless, however, and in high concentrations destroys the sense of smell. In sufficient concentrations it paralyzes the respiratory nerves resulting in death, either instantaneously or shortly after the poisonous vapors have been inhaled.

The principal hazard in the handling of $H_2S$ bearing crudes and gases is found where ventilation is poor or where there is no ventilation. Since the gas is heavier than air it has a tendency to drift into and lie in low places, such as ravines, creeks, tank dikes, bell holes, excavations, inside the shell of floating roof tanks, conduits, manifolds, inside of tanks, pits, and other places where there is no free movement of air. These places should be avoided when the presence of gas is suspected except when the proper type of respiratory protection is being used.

In order to remove petroleum vapors from station pump rooms, Service Pipe Line Company has devised an efficient and low-cost ventilating system consisting of a 6000 cubic feet per minute squirrel cage fan (Figure 1); a two-horsepower electric motor with couplings and shafting to extend through the fire wall between the pump room and the engine room (Figure 2); approximately 18 feet of 26-gauge galvanized iron duct 18 inches in diameter to reach from the fan to a point a foot above the roof of the pump house (Figure 3); about seven feet of 24-inch duct reaching from the air intake of the fan through the pump room floor into the interconnected piping conduits, and six louvers for admitting air from the floor into these conduits.

Figure 4 is a floor plan of the installation. One pump station has already been equipped with the system and plans are being made for additional installations.

The principle of operation of the ventilating system is that the $H_2S$ vapors, since they are heavier than air, will settle to the floor of the pump room, and will be pulled through the louvers into the conduits by the action of the suction fan. The vapors would then, of course, be exhausted above the roof through the 18-inch duct. During cold weather the doors and windows of the pump room are kept closed, and a small amount of fresh air is admitted into the pump room through the roof vents. The ventilating system takes cold air off the floor, thus pulling the hot air downward from the ceiling. This utilizes part of the hot air which is ordinarily lost through the ceiling or roof and provides uniform temperatures throughout the pump room. Tests have shown that the temperature in the working area immediately above the pump room floor increases, thus reducing the



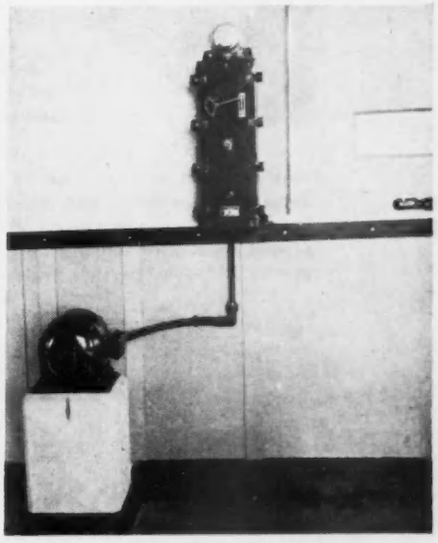
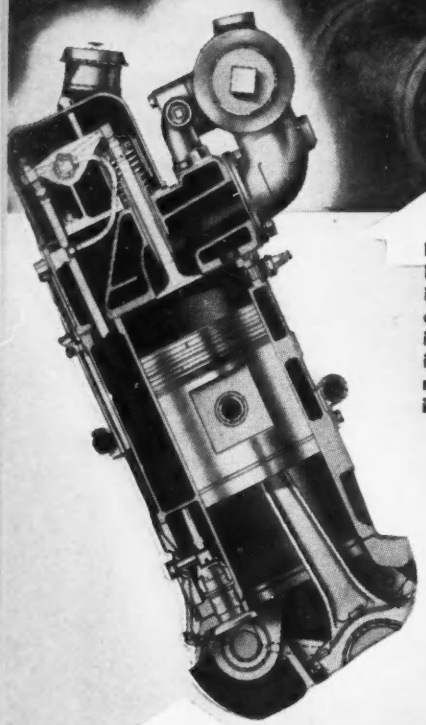
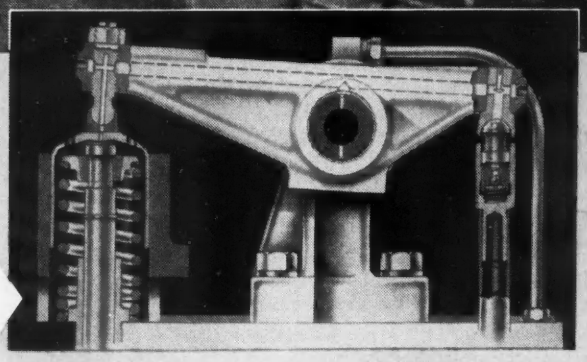


**FIGURE 1 (left). Six thousand feet per minute squirrel cage suction fan with 24-inch duct leading from the interconnected conduits to the intake side of the fan. A portion of the 18-inch discharge duct is also shown. The drive shaft of the fan extends through the fire wall shown in the background. FIGURE 2 (right). Two-horsepower motor and controls for 6000 cubic feet per minute fan. This installation is on the engine room side of the fire wall.**

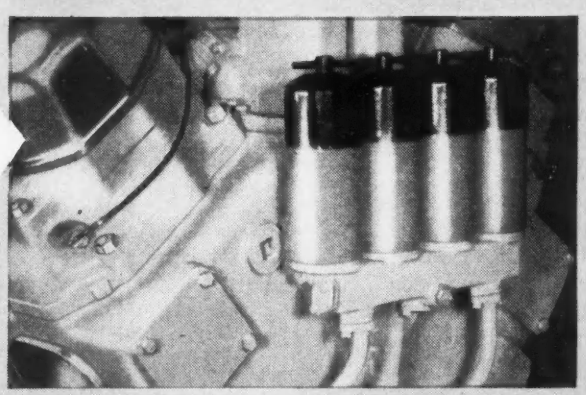
# Dependable



Here's a modern pipeline installation of Le Roi 600 (max) hp L-3460 engines driving multi-stage pumps through speed increasers. Le Roi's 13 years of experience in the pipeline field was a major factor in bringing out the 600 hp L-3460 to meet the industry's need for more power in a low-cost, medium-speed engine.



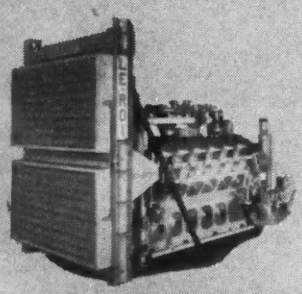
The 600 hp L-3460 is equipped with "zero-lash" hydraulic valve lifters. They eliminate tappet adjustments, increase valve life, make possible smooth, trouble-free operation.



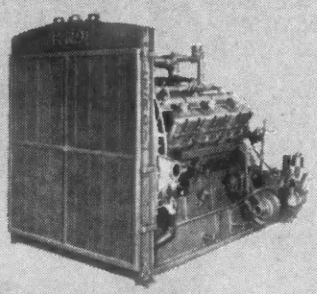
Full-flow, by-pass oil filters and coolers provide sure engine protection — still greater dependability.

Here's a cross section of an RX series engine. Note the guided valve stem mechanism and controlled water circulation around the valves that give long valve and valve-seat life. Light aluminum pistons with full-floating pins are cam-ground and tapered for precise fit, make possible faster acceleration, smoother running.

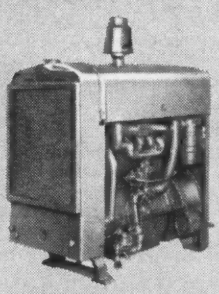
## There's a Le Roi Engine for Every Oil Field Need



L-3460
HP range 280-600



RX Series
HP range 79-410



D Series and H-540
HP range 6-155

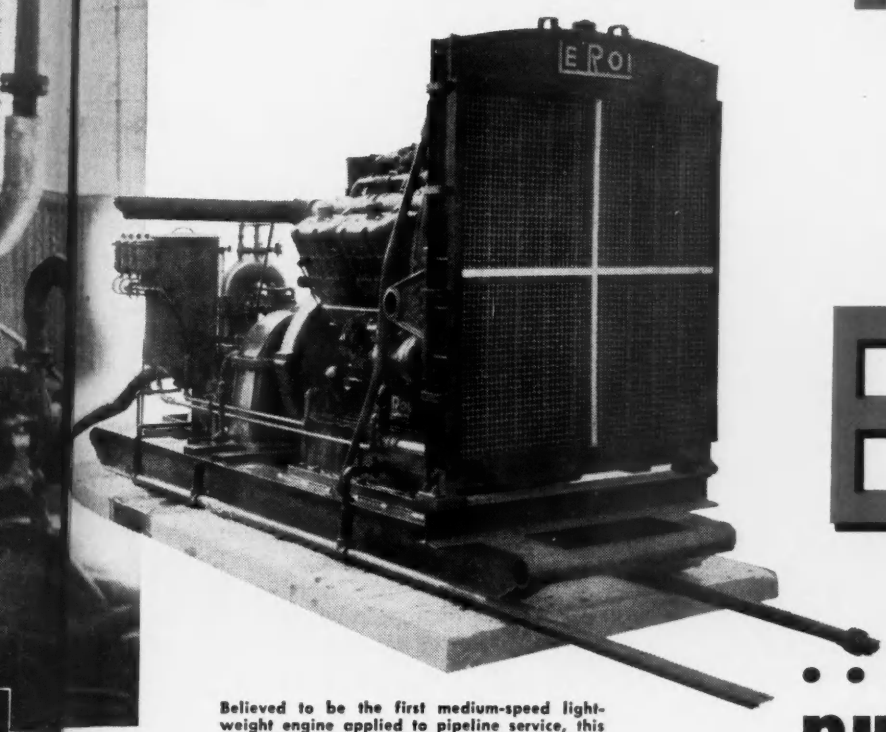
## A Typical Le Roi Service Facility

Here's the efficient, well-arranged parts department of Le Roi-Rix Co.'s Long Beach branch. Two more offices — at Bakersfield and Los Angeles — are similarly equipped. All three offices maintain prompt 24-hour service. Le Roi has service facilities like these throughout the oil fields — another reason why you can depend on Le Roi.

# low-cost power—

# Le Roi Engines

## . . . for pipeline pumping service




Believed to be the first medium-speed lightweight engine applied to pipeline service, this Le Roi V-8 still operates dependably and efficiently in a major pipeline station at Placido, Texas.

## Medium-speed, lightweight Le Roi engines save money on initial investment, and maintenance

An interesting trend was started in 1938, when the Engineering Department of a major oil company decided to use medium-speed, lightweight Le Roi engines in place of conventional, slow-speed, heavyweight units on a main pipeline installation.

The choice of Le Roi was fully justified. The horsepower per dollar cost was lower. The engines were easier to service — service parts more easily obtained. And performance proved to be dependable and economical. Repeat orders followed until the pipeline project was 100% powered by Le Roi. All ten units are still giving good service.

As news of this successful installation spread Le Roi's popularity for pipeline service grew — and an ever-increasing number of Le Roi installations are being made in other fields. Yes, they're swinging to Le Roi — because Le Roi dependability and low-cost maintenance keep operating expenses to a minimum. Moreover, Le Roi engines are backed by complete service facilities in every active area.

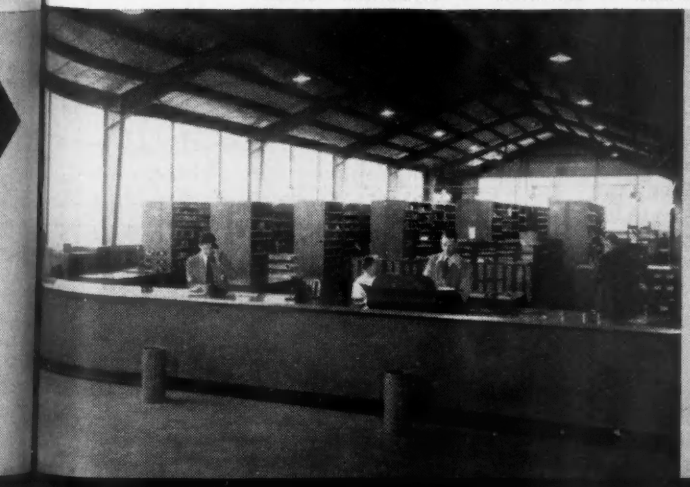
No matter what your engine application is, it pays you to call on your nearby Le Roi distributor. He can show you Le Roi engines at work under conditions similar to yours. See why Le Roi *leads the field — in the field.*

# LE ROI COMPANY

**MILWAUKEE 14, WISCONSIN**

*Plants:* **Milwaukee • Cleveland • Greenwich, Ohio — Oilfield Headquarters: Tulsa, Oklahoma**

P-168



### LEADS THE FIELD

*Le Roi Oilfield Sales*

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Le Roi Company Branch — Tulsa
Carson Machine & Supply Co.— Oklahoma City

**East & South Texas, Gulf Coast**
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

**North & West Texas, New Mexico**
General Machine & Supply So. — Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

**Kansas**
Carson Machine and Supply Co.—Great Bend

**Illinois — Western Kentucky**
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

LE ROI

### IN THE FIELD . . .

*Service Network*

**Michigan**
Hafer Engine Service — Reed City

**Rocky Mountain Area**
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Col.

**Northern Louisiana & Mississippi**
Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

**West Coast**
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

**Appalachian Area**
P. C. McKenzie Co., Pittsburgh, Bradford.

**Canada**
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

consumption of fuel for heating purposes when the ventilating system is being used.

The fan is equipped with intermittent operating controls which permit flexibility of operation conforming to weather conditions. When the fan is running it removes slightly more than 5000 cubic feet of air per minute from the pump room, providing 12 complete changes of air per hour. With that amount of air being removed from the pump room the concentration of $H_2S$ and other petroleum vapors is kept at a minimum, thus providing plenty of fresh air and eliminating explosion hazards during normal operations. By installing metal hoods over the plungers of the reciprocating pumps and connecting a vent line from the hoods to the piping conduits, all traces of $H_2S$, including the obnoxious odor, are removed from the pump room.

Although sour crudes are found in many oil producing areas of the world, rapid development of sour crude production in many new regions during the past few years poses the problem of educating field personnel not fully acquainted with this hazard. Victims of hydrogen sulfide poisoning should be quickly removed to fresh air, and artificial respiration should be applied.

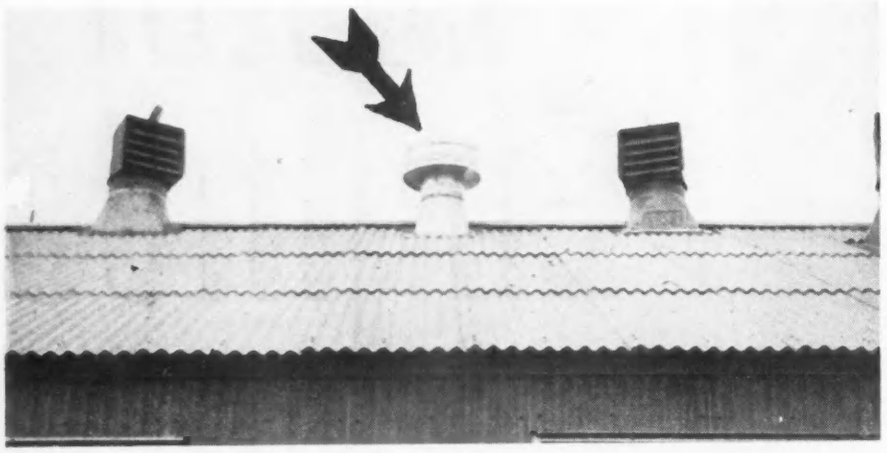

FIGURE 3. Ventilator (arrow) on top of 18-inch air exhaust duct which extends one foot above the roof.

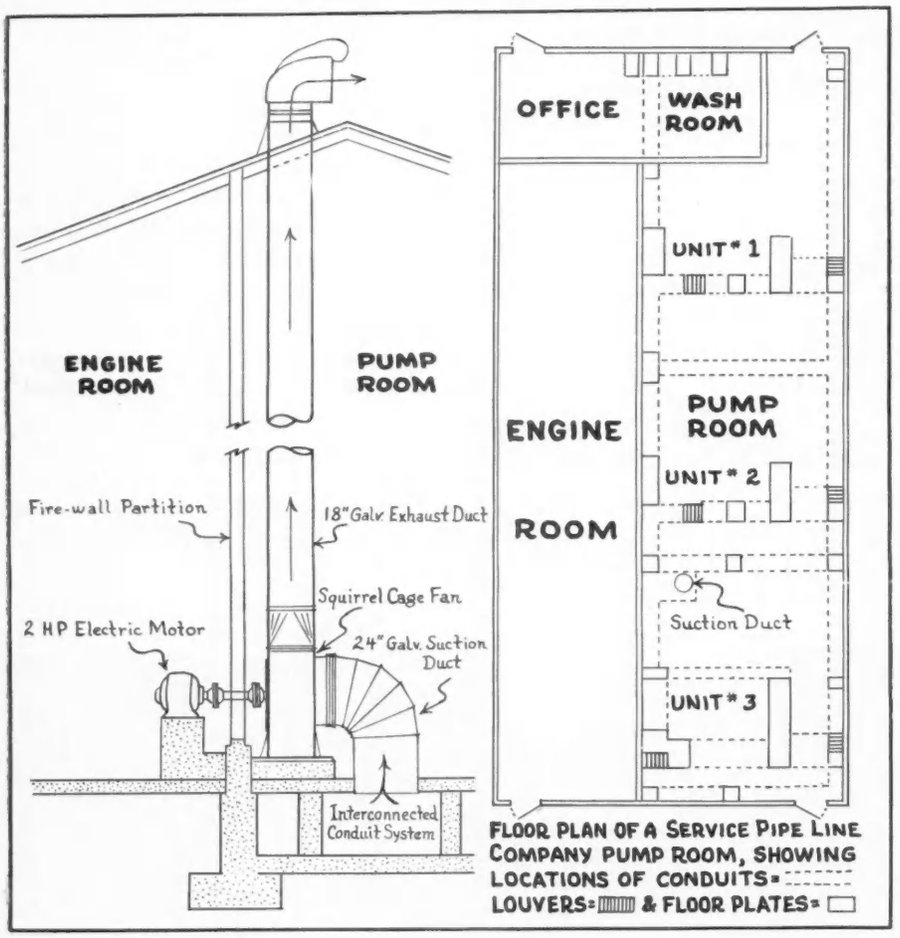


FIGURE 4

Hydrogen sulfide gas is toxic to human beings but with due care all types of $H_2S$ bearing crudes and gases can be handled without undue risk. The physiological effects of hydrogen sulfide gas range from shortness of breath and burning and irritation of the eyes and respiratory organs to sudden death, depending entirely upon the concentration of the gas encountered, and the length of exposure. In low concentrations a person may work for several hours without any ill effects; but, as stated previously, in high concentrations death may occur instantly. $H_2S$ paralyzes the nerve centers which control the respiratory organs. The heart continues to beat after respiration ceases; therefore, artificial respiration is very effective for reviving those overcome by the gas, and many have been saved by this means. Every person working around hydrogen sulfide-bearing crude or gas should be able to administer artificial respiration by the Schaeffer prone-pressure method.

As previously pointed out, anyone overcome by $H_2S$ should be removed to fresh air and artificial respiration started immediately. Artificial respiration should continue until breathing is restored or until rigor mortis sets in.

After the patient is revived, if breathing stops, artificial respiration should again be applied. In all cases of asphyxiation a doctor should be called immediately.

In cases of extreme hydrogen sulfide gas poisoning where death does not occur, pneumonia frequently follows. After the patient recovers from pneumonia there usually are no bad after effects. The after effects of $H_2S$ poisoning range from none to a mild irritation of the nasal passages and respiratory tract. It is noteworthy that the vapors from mineral waters used for drinking, swimming and other therapeutic purposes in some health resorts contain as much as .0010 percent $H_2S$ by volume.

Self-contained air masks should be used by employes at all locations where gas concentrations are considered to be such that adequate oxygen is not available in the air, and in all locations where crude contains $H_2S$ in high concentrations.

# PIPE LINE *Construction*

By SYLVIA LILLIE, WORLD OIL Staff

## Projects Announced and Contracts Awarded

*Crude Oil Lines*

**Texas-New Mexico Pipe Line Company** plans to build 75 miles in three 8-inch lines in West Texas. One will run from Midland into the Germania pool, one from Midland to the Scharbauer and Sweetie-Peck areas, and the third from the company's Crane station to new production in the McElroy area.

**Texas-New Mexico Pipe Line Company** plans a 55-mile, eight-inch line from its system at Eunice to the Lovington and Saunders areas of Lea County, N. M.

**Trans Mountain Oil Pipe Line Company,** sponsored by Bechtel Corporation, Los Angeles, proposes a 715-mile line from the Edmonton, Alberta, area to the Pacific coast cities of British Columbia, Washington, and Oregon. It would have an initial capacity of 75,000 barrels per day, an ultimate throughput of 200,000 bpd.

**Union Sulphur and Oil Corporation** plans 20 miles of four- and six-inch connecting the Cree-Sykes pool in West Texas to Humble Pipe Line Company's Ballinger station.

*Products Lines*

**Standard Oil Company of Indiana** plans 144 miles of eight-inch from Neodesha, Kansas, to Sugar Creek, Mo.

*Natural Gas Lines*

**Central Kentucky Natural Gas** applied to FPC for authority to build 13 miles of 20-inch northwestward from North Means, Ky.

**El Paso Natural Gas Company** is seeking authorization to build ten miles of 30-inch main line loop, 36 miles of field lines, and 56,070 horsepower in new and existing stations.

**El Paso Natural Gas Company** asked permission to increase its delivery to Pacific Gas & Electric Company at Topock, Ariz., by 100 Mmcf daily. It would build 51 miles of field lines and install 27,750 additional hp in main line compressor stations and a field plant.

**El Paso Natural Gas Company** requested authority to build 113 miles of 30-inch loop, 180 miles of field lines, and 134,740 hp in additional compressor capacity. Gas would be delivered at points on the Arizona-California border to Southern California Gas Company, Southern Counties Gas Company, and Pacific Gas & Electric Company.

**Gulf-Michigan Gas Transmission Corporation** has applied for authority to construct 680 miles of 30-inch between Perryville, La., and St. John, Ind., with a 25-mile lateral from Belleville, Ill., to the east bank of the Mississippi River opposite St. Louis. The system, with three compressor stations of approximately 30,800 hp, would supply 150 Mmcf daily to the St. Louis area, and 200 Mmcf to Michigan-Wisconsin Pipe Line Company at St. John.

**Hope Natural Gas Company** asked FPC permission to build a 32-mile line from Terra Alta field to its system near Fairmont, W. Va.

**Interstate Power Company** has been authorized to construct 26 miles of eight-inch from the facilities of Natural Gas Pipeline Company of America near Hooppole, Ill., to Clinton, Iowa.

**Manufacturers Light and Heat Company** applied to FPC for permission to build 144 miles of 16-inch from Gallagher Township, Clinton County, to Westmoreland County, Penn.; 10 miles of 20-inch from Westmoreland County to Clairton, Alleghany County; and 18 miles of 24-inch from Clairton to Tannehill farm in Washington County.

**Mississippi River Fuel Corporation** asked permission to lay 98 miles of 16- and 18-inch from Woodlawn field, Harrison County, Texas, to The California Company's plant in Lincoln Parish, La., with an 11-mile, ten-inch lateral to Waskom field, Texas.

**Montana Power Company** applied for FPC authority to build a 40-mile, eight-inch line from Hart Mountain field, Wyo., to Warren, Mont.

**New York State Natural Gas Corporation** has awarded contract to Williams-Austin Company, Pittsburgh, to build 79 miles of 20-inch from Dryden to Utica, and 85 miles of 16-inch from Utica to Albany, N. Y.

**New York State Natural Gas Corporation** let a contract for 23 miles of 20-inch between the New York - Pennsylvania state line and Angelica, N. Y., to Williams-Austin Company, Pittsburgh.

**Niagara Mohawk Power Corporation** awarded contract for a 55-mile, ten-inch line from New York State Natural's system at Fulton to Watertown, N. Y., to Williams-Austin Company, Pittsburgh.

**Ohio Fuel Gas Company** applied to FPC for permission to construct 61 miles of transmission line in northern and southwestern Ohio to meet increased demands in the Sandusky, Elyria, and Dayton market areas.

**Pacific Gas and Electric Company** asked permission to build 141 miles of 34-inch loops along its Topock-Milpitas line, increasing its capacity by 150 Mmcf per day.

**Piedmont Gas Company, Inc.** applied for authority to serve several communities in North Carolina by building 28 miles of six-inch connections with Transcontinental Gas Pipe Line Corporation's system.

**Shenandoah Gas Company** asked authorization for 59 miles serving communities in the Shenandoah Valley from a connection with Virginia Gas Transmission Corporation's system near Strassburg, Va.

**Tennessee Gas Transmission Company** has awarded contract for a 47-mile, 30-inch loop between West Monroe and Mer Rouge, La., to Houston Contracting Company, Houston; and for a 59-mile, 30-inch loop from Parsons to Dickson, Tenn., to Western Pipeline Constructors, Inc., Austin. Both loops will be started in June.

**Tennessee Gas Transmission Company** and **United Natural Gas Company** have asked FPC authority to build 6 miles of 6-inch and 6 miles of 8-inch in connection with an underground storage project at Hebron field, Potter County, Penn.

**Texas Eastern Transmission Corporation** has let contract to Williams Bros.-Davis Company, Houston, for 165 miles of 30-inch from Kosciusko, Miss., to Florence, Ala.

**Texas Eastern Transmission Corporation** has given a contract to E. J. Mahoney Contracting Company, Lansing, Mich., for the building of 36 miles of 30-inch injection and withdrawal lines from its system at Connellsville to the Oakford storage area in Pennsylvania.

**Texas Gas Transmission Corporation** asked FPC permission to construct 189 miles from Acadia Parish to its facilities in Morehouse Parish, La., and 425 miles of loop line between Bastrop, La., and Hardinsburg, Ky. A new 5280-hp station will be built at Madison, Ind., and 9340 additional hp installed in four existing stations.

**Texas Gas Transmission Corporation** has been granted FPC permission to build a 12-mile line from its system in Indiana to the Alford storage field.

**Transcontinental Gas Pipe Line Corporation** has awarded contract for 15 miles of 24-inch from the east side of the Hudson River to the New York-Connecticut border, for ten miles of 26-inch across Staten Island from East Carteret, N. J., and four miles of 24-inch through the narrows of the Hudson River to Brooklyn to H. C. Price Company, Bartlesville, Okla.

**United Natural Gas Company** asked FPC authorization to build ten miles of new lines in Elk, McKean, and Venango Counties, Penn., and eight miles of replacement lines in Elk and Venango Counties.

**United States Engineers** plan 190 miles of six-inch from Searsport to the U. S Army base at Limestone, Maine. Associated Pipe Line Contractors, Inc., Houston, has been given the contract.

**Utah Natural Gas Company** has the approval of the Utah Public Service Commision to build a 325-mile, 22-inch line from the Four-Corners area to Salt Lake City.

## Projects Starting

*Crude Oil Lines*

**Phillips Petroleum Company** started in April 12 miles of 24-, 26-, and 30-inch in Burbank field, Osage County, Okla. Trojan Construction Company, Oklahoma City, is the contractor.

**Platte Pipe Line Company** has begun work on its 1078-mile line from Worland, Wyo., to Wood River, Ill. R. H.

Fulton & Company, Lubbock, Texas, started in April 573 miles of 16- and 20-inch from Winchester, Wyo., to Holdredge, Neb.; O. R. Burden Construction Corporation, Tulsa, will start in May 280 miles of 20-inch from St. Joseph, Mo., to Wood River.

**Socony Vacuum Oil Company** started in March eight miles of ten-inch north of Hutchinson, Kansas. Knupp Construction Company, Inc., Great Bend, Kansas, is the contractor.

**Sun Pipe Line Company** started in March 24 miles of eight-inch from the North Snyder pool to the Basin Pipe Line System at Colorado City, Texas. Crosely & Hardy Pipe Line Construction Company, Wichita Falls, Texas, is the contractor.

**Tex-Harvey Pipe Line Company** (owned by Phillips Petroleum Company and Cities Service Oil Company) is building 56 miles of 6-, 8-, and 12-inch through the producing areas of Midland, Glasscock, Reagan, and Upton Counties, Texas. Phillips' crude will be turned into its 12-inch line at Goldsmith, and Cities Service crude will go to the Basin system tank farm in east Midland County.

*Natural Gas Lines*

**Canadian Western Natural Gas Company, Ltd.** is building 22 miles of six-inch and 30 miles of eight-inch from Jumping Pound field to Banff, Alberta. Company crews are doing the work.

**Dow Chemical Company** started in March 28 miles of 14-inch, nine miles of 12-inch, ten miles of four-inch between Sweeny and Lake View, Texas. Massey Pipe Line Construction Company, Corpus Christi, is the contractor.

**Hugoton Production Company** is building 40 miles of 4- to 20-inch gathering system near Ulysses, Kansas. Reese Bros. Construction Company, Hugoton, Kansas, is the contractor.

**Kansas-Nebraska Natural Gas Company** started in March 66 miles of 12-inch replacement lines in Kansas and Nebraska, and 16 miles of 12-inch loop between Wakeeney and Palco, Kansas. Cheek Construction Company, Ulysses, Kansas, is contractor.

**Niagara Mohawk Power Corporation** started in April 40 miles of 10-, 12-, and 16-inch laterals in the vicinity of Utica, N. Y. Williams-Austin Company, Pittsburgh, is the contractor.

**Panhandle Eastern Pipe Line Company** started in March 25 miles of four-inch near Guymon, Okla. Knupp Construction Company, Inc., Great Bend, Kansas, is the contractor.

**Tennessee Gas Transmission Company** started in April the following main-line loops: 24 miles of 26-inch southward from Falfurrias, Texas, Oklahoma Contracting Company, Dallas, contractor; 40 miles of 30-inch from Cypress to Fostoria, Texas, 30 miles of 30-inch from Woodville to Jasper, Texas, 43 miles of 30-inch from the Sabine River to Natchitoches, La., all being built by Houston Contracting Company; 93 miles of 30-inch from Drew to Holly Springs, Miss., 67 miles of 30-inch between Glasgow and Lebanon, Ky., under construction by Anderson Bros. Corporation, Houston; 62 miles of 30-inch between Richmond and Salt Lick, Ky., with Western Pipeline Constructors, Inc., Austin, as contractor.

## Projects Completed

*Crude Oil Lines*

**Humble Oil Company** completed in April eight miles of four-inch and eight miles of eight-inch in the Trinity Bay area. Brown & Root, Inc., Houston, was the contractor.

**Shell Pipe Line Corporation** completed the end of March five miles of four-inch from Pardue field to Shell's Hamlin station, and nine miles of four-inch from East Hamlin field, Jones County, to Hamlin station. Ferguson Construction Company, Eunice, N. M., was the contractor.

*Products Lines*

**Miami Valley Corporation** will complete in May 58 miles of eight-inch between Cincinnati and Dayton, Ohio. Anderson Bros. Corporation, Houston, is the contractor.

*Natural Gas Lines*

**Delhi Oil Company** completed in April 70 miles of eight-inch from Lopeno field, Zapata County, to Laredo, Texas. Altgelt Construction Company, Corpus Christi, was contractor.

**El Paso Natural Gas Company** completed in April its 451-mile, 24-inch line from the San Juan Basin of New Mexico to Needles, Calif. Company crews did the construction.

**Tennessee Gas Transmission Company** completed a 25-mile, 12-inch line from Grand Chenier to Rollover, La. Houston Contracting Company did the construction.

**Tennessee Gas Transmission Company** completed in April 30 miles of 30-inch loop line in the vicinity of Victoria, Texas. Oklahoma Contracting Company, Dallas, was contractor.

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# How to do it! PIPE LINE HINTS

**$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas**

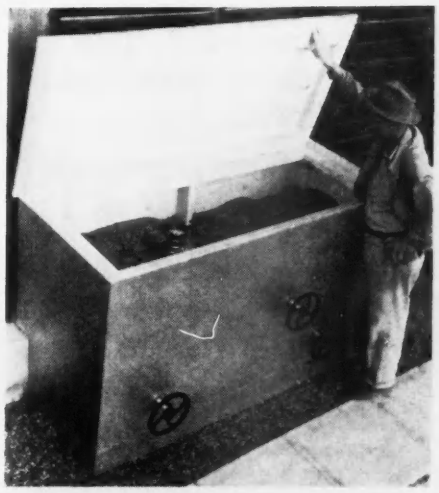
## HOW TO—Provide Efficient Water Valve Insulation

An inexpensive and convenient box containing insulating cork chips was constructed for Transcontinental Gas Pipe Line Company to protect water meters and above-ground water valves against freezing. The box was made of 2 x 4's, some 1 x 8 shiplap, and galvanized sheet metal. This installation has the advantage of enabling personnel to read the water meter and operate valves regardless of temperature conditions.

A 2 x 4 frame was built to enclose all the piping to be insulated. Top and bottom were left open. Holes were drilled in this siding to allow valve stems, etc., to reach outside the box. The sides were then covered with galvanized sheet metal.

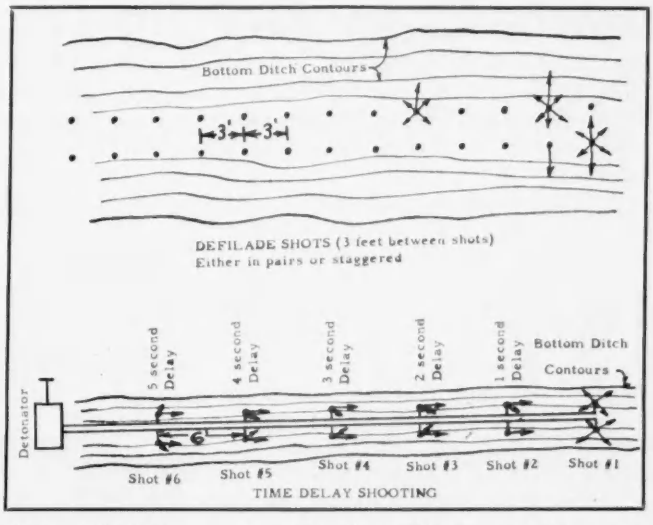
A hinged top was made by nailing 1 x 8's on a rectangular 2 x 4 frame and covering with galvanized sheet metal. Care was taken to insure that this top fitted the box snugly and that the 2 x 4 rectangular lid frame would clear the inside top plates of the box frame when the lid was closed.

After the box had been painted and the valve wheels replaced, the cork chips were poured to a level slightly below the top of the water meter, as shown.



## HOW TO—Improve Method of Blasting Ditch in Rock

The usual technique employed in blasting pipe line ditches through rock is to drill shot holes at close intervals to a depth considerably below the elevation of the bottom of the proposed ditch, load the holes, tying all charges to a common exploder, and then "let 'er go." Following the defilade shot, which may extend for several hundred feet, back hoes are necessary to remove the debris from the ditch while bulldozers level the work side. Since the force of the explosion follows the path of least resistance, the main force of the blast is upward, resulting in a ditch whose cross section resembles a shallow V, the angle on either side being roughly equal to the angle of repose of the loose rock. And often this leaves little work room, particularly if the line is being laid on a restricted or narrow right-of-way.




Time delay shooting overcomes most of the disadvantages of defilade shooting, using fewer shot holes, yet blasting a narrow straight-walled ditch. In this type shooting, the shots follow one another in a definite planned sequence. An example of this method of shooting is illustrated. Although the shot holes are of a depth equal to that of the defilade method, they are spaced about twice as far apart. This procedure saves shot holes and dynamite, more or less compensating for the added expense of electric time delay caps.

These caps are made so that the exploder need be pushed only once to set off the entire sequence of shots that go off at set intervals. The first shot will exert its main force upward in blasting the first holes. However, the second shot will expend its force primarily in the direction of the cavity or fracture made by the first shot since there is less resistance in that direction. And the force of succeeding shots will be directed toward previous shots.

In this manner, a narrow straight ditch with almost perpendicular walls is formed. Since the force of the explosion is down the ditch line, much of the rock and debris will stay in the right-of-way, thereby leaving more space on the work side and minimizing damage to crops.

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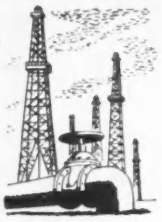

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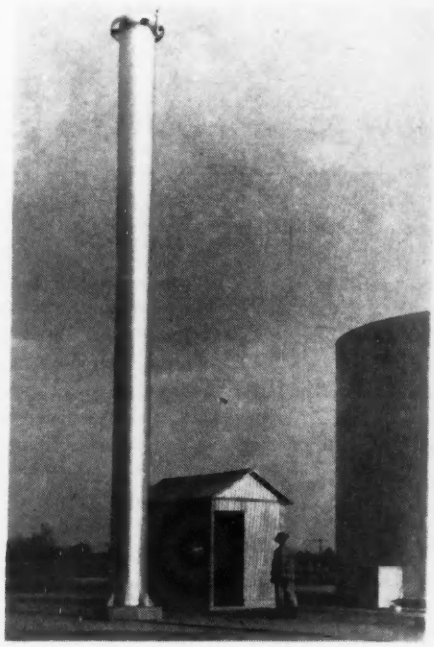
# HOW TO—Store Water Economically

A standpipe designed to save the expense of a conventional elevated water storage tank was inexpensively built of 24-inch pipe and other materials found on any compressor or pump station construction job.

The body of the standpipe was made from a 45-foot length of 24-inch line pipe. The bottom was a half-inch circular steel plate, three feet in diameter, welded to the 24-inch pipe. Eight triangular gussets cut from ⅜-inch plate were spaced every 45 degrees around the circumference of the bottom and welded both to the pipe and to the circular steel plate. Midway between these gusset plates, 1½-inch holes were drilled for anchor bolts.

A three-foot diameter circular steel ring was supported at the top of the standpipe by means of "T" sections fabricated from ⅜-inch steel. This ring provides support for painting, and attached to it is the pulley for the gauge line that runs from the float inside the tank to the target outside.

The foundation for the standpipe was designed to overcome any normal overturning moment. However, guy wires can be added if deemed necessary.



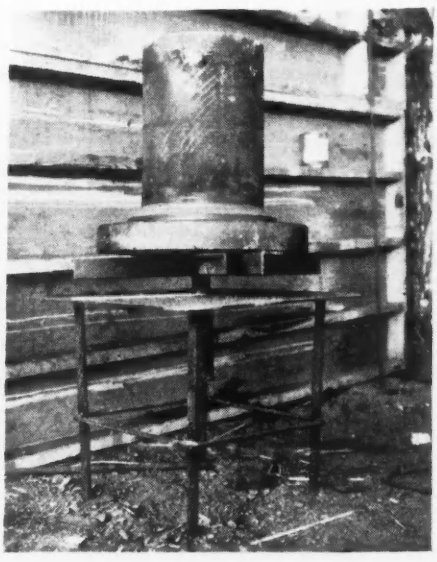
This standpipe was designed to float on the domestic water system and it has the usual float switches that start the pumps when the water falls below a specified head.

# HOW TO—Construct Jig for Flange

An inexpensive welding jig was constructed to permit a flange to be rotated by a welder as it is being welded to the pipe.

This jig, shown in the accompanying illustration, was made of scrap reinforcing steel, scrap steel plate and short lengths of 2-inch and 1½-inch pipe.

First a table was constructed by welding a two-foot square piece of one-quarter-inch steel plate to four legs of one-inch reinforcing steel. These four legs were cut to a convenient height and braced as shown. A 12-inch length of two-inch pipe was welded flush with the table top and closed at the lower end with one-quarter inch steel plate. An 18-inch length of 1½-inch pipe, the lower end fitted inside the two-inch pipe to serve as an axle around which the flange rotates, was welded to a cross made of heavy two-inch angle iron. One leg of this cross was made of two pieces of angle iron with the flanges turned out, thereby permitting one-inch stud bolts to pass between the inside edges to allow flanges of different sizes to be bolted to the jig.



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| Electric Resistance and Fusion Weld—Plain End | 8⅝" to 20" O.D. | Up to 40' | .188" to .500" | Napa, Calif.—Basalt-Kaiser |
| Electric Resistance Weld—Plain End | 5⅝" to 12¾" O.D. | Up to 55' | .188" to .400" | Fontana, Calif. |
| Electric Fusion Weld—Expanded—Plain End | 22" to 30" O.D. | Up to 40' | .188" to .500" | Napa, Calif.—Basalt-Kaiser |

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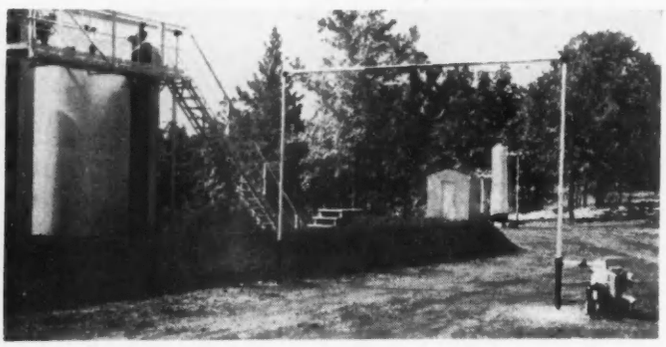
# HOW TO—Rig Convenient Truck Loading Facilities



When oil is trucked out from wildcat leases before pipe lines have been laid, the connection for loading is usually an unsightly line laid across the top of the fire wall with a connection on the end. However, simple connections may be made which will pay for themselves if they are rigged up when the tank battery is built.

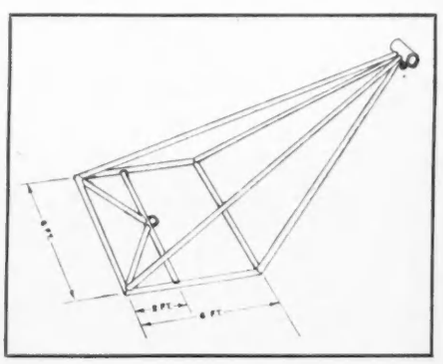
As shown, the line from the tank is laid underground to the suction of the pump which is across the roadway from the tank battery. The pump discharge is connected to a riser which supports one end of a line which runs above the top of the trucks. This line carries a rubber hose in the center which the truck driver can drop into the tank as soon as the truck is stopped. This puts all spillage into the apron around the loading connection on the truck and no oil is spilled on the ground.

The other end of the loading line is supported by another riser set in concrete. A connection may be made on the bottom of it to make it possible to transfer oil between the tanks or through a treating plant when it has been put into operation.

# HOW TO—Fabricate Demountable Side Boom for Truck

A demountable side boom for a winch truck mounted directly behind the cab was fabricated by the maintenance crew of a pipe line operating company.

A 6 x 6-foot square base was made of two-inch pipe. A six-foot length of two-inch pipe was welded transversely between the laterals of the base, two feet in from the side opposite the boom arm and braced to the near corners. A loop of three-quarter-inch steel welded to the middle of this member provided an eye for a snatch block.



Compression and tension members of the boom arm are made of two-inch pipe, with the foot ends welded to the four corners of the square base. The four opposite ends converge at the crown, overhanging the square base about four feet.

A six-inch length of extra-heavy four-inch pipe with an eye of three-quarter-inch steel holds the upper snatch block in place. When in use, the entire boom frame assembly is tied down to the truck bed with heavy steel chains and cinched with load binders.

After the boom arm is chained to the truck and the blocks are hooked in the eyes, the winch line is reeved through sheaves. When the winch truck is needed for material hauling jobs only, the boom arm frame is dismounted.

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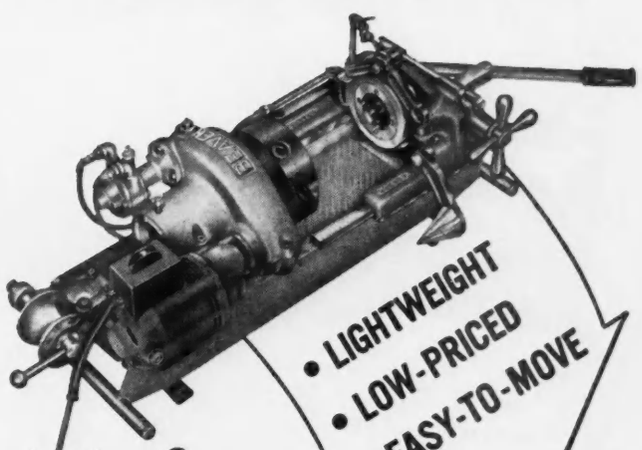


## the New Beaver Model-E Pipe and Bolt Machine

The new low-priced, lightweight Beaver Model "E" is a "junior edition" of the heavy-duty Beaver Model A—which has, for the past 20 years, been the recognized leader in the field of portable pipe and bolt machines.

Although designed primarily for hardware stores and small piping contractors and industrialists, BIG contractors will find the new Model "E" useful on jobs requiring extreme portability.

A pipe machine is no better than the service back of it and our 50 years of experience in this field, and our reputation for high quality and friendly service, is your best guarantee of complete satisfaction.

WRITE FOR BULLETIN E

BEAVER PIPE TOOLS

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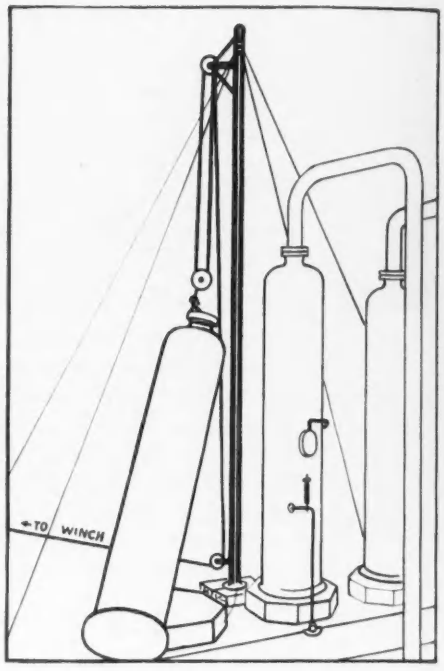
# HOW TO—Install Extra Scrubber in Hazardous Area

A novel arrangement of gin pole and pull angle was used by one company to minimize the hazard involved in erecting an additional scrubber in a high-pressure gas area.

An additional scrubber was being added to a battery of five existing scrubbers. Adjoining scrubbers, headers and risers were filled with high-pressure gas, creating a hazard to equipment and personnel should the scrubber fall and strike adjacent piping.




First, a gin pole capable of handling twice the weight of the scrubber was made of 10¾-inch pipe and set on heavy timber, about two feet from the adjacent scrubber as shown in the drawing. The top of the scrubber was moved onto the foundation directly below the block atop the gin pole. The bottom of the scrubber was moved to such a position that should the hoisting line break during the lifting operation, the scrubber would simply tilt over between the gin pole and adjacent scrubber, and be cradled there, rather than topple over and fall with force on adjacent piping.

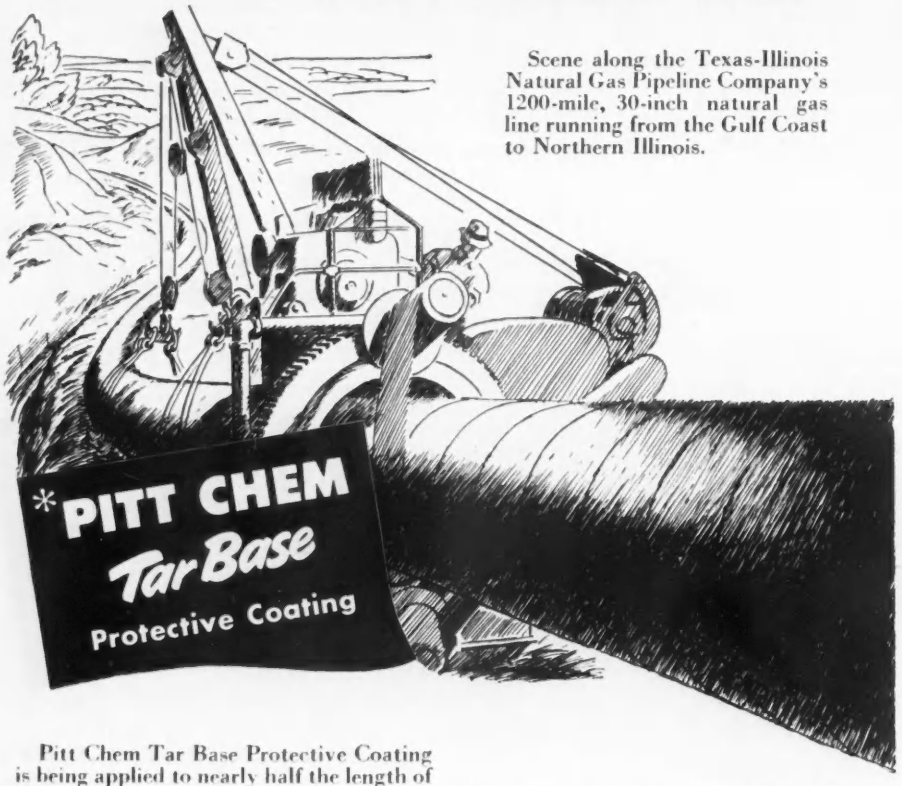
The bottom of the pole was lashed to the scrubber foundation with wire rope and further held in place with reinforcing steel spikes driven into the heavy supporting timbers through holes in the bearing plate.

The winch line of a 2½-ton truck was reeved through a block at the bottom of the pole, thence through blocks atop the pole and scrubber to give the truck an advantage of two in the pull. Thus there was little strain on the truck winch line during the setting operation.

The relatively simple method described will speed the process of installing the extra scrubber in close quarters, as well as eliminate the danger of possible injury to workmen and damage to equipment which might occur if the scrubber were to fall and strike nearby high-pressure gas piping.


*Life-Saving "Skin"**

**for another BIG INCH pipeline**




Scene along the Texas-Illinois Natural Gas Pipeline Company's 1200-mile, 30-inch natural gas line running from the Gulf Coast to Northern Illinois.

Pitt Chem Tar Base Protective Coating is being applied to nearly half the length of the new steel pipeline that will soon carry gas from the Corpus Christi area to Joliet, Ill. It's one of the basic materials of a tough, metal-preserving sheath that will guard against underground corrosion and add years of life to the vital line.

This reinforced tar base coating provides more than just "life insurance" for this $120,000,000 transportation system. Because of its unvarying top quality—maintained by painstaking laboratory control—Pitt Chem pipeline coating performs better on application, serves better and longer underground.

This same *quality-assurance* is an important advantage when you use *any* of Industry's Most Comprehensive Family of Protective Coatings . . . whether it's a Pitt Chem Alkyd, Chlorinated Rubber, Vinyl or Phenolic base coating. For more information about these versatile, equipment-saving coatings, send for booklet, "Control Corrosion Through Pitt Chem Protective Coatings."

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Peace River terrain from the air. The road is for winter exploration work.

# Alberta Flying Magnetometer Survey Completed

By THOMAS M. O'MALLEY
President, Canadian Aero Service, Ltd., Ottawa, Ontario

FINAL maps have been delivered to the four oil companies who jointly made the Peace River airborne magnetometer survey in Northwestern Canada. The survey began in late May, 1950, and was completed in late August; the detailed aeromagnetic data was compiled in 27 map sheets covering the survey's 16 million acres. (WORLD OIL, September, 1950).

Survey costs—in the neighborhood of $150,000—were shared by Socony Vacuum Exploration Company, Stanolind Oil & Gas Company, Imperial Oil, Ltd., and Canadian Gulf Oil Company. The survey was executed by Canadian Aero Service, Ltd.

Why was this cooperative exploration project undertaken? First of all, the Peace River area is extensive and the regional geology is not well known. Secondly, the terrain is difficult to traverse on the ground; there are dense stands of timber and boggy muskeg as exploration obstacles. Finally, the play here is active, and the air survey delivers one complete phase of geophysical information very quickly for the participants. In fact, by agreement among the four companies, the map compilation was scheduled to deliver one company's areas of interest first because their concession arrangements required immediate decisions. The magnetic maps were in their geologists' hands in late September, four months after the first survey flight.

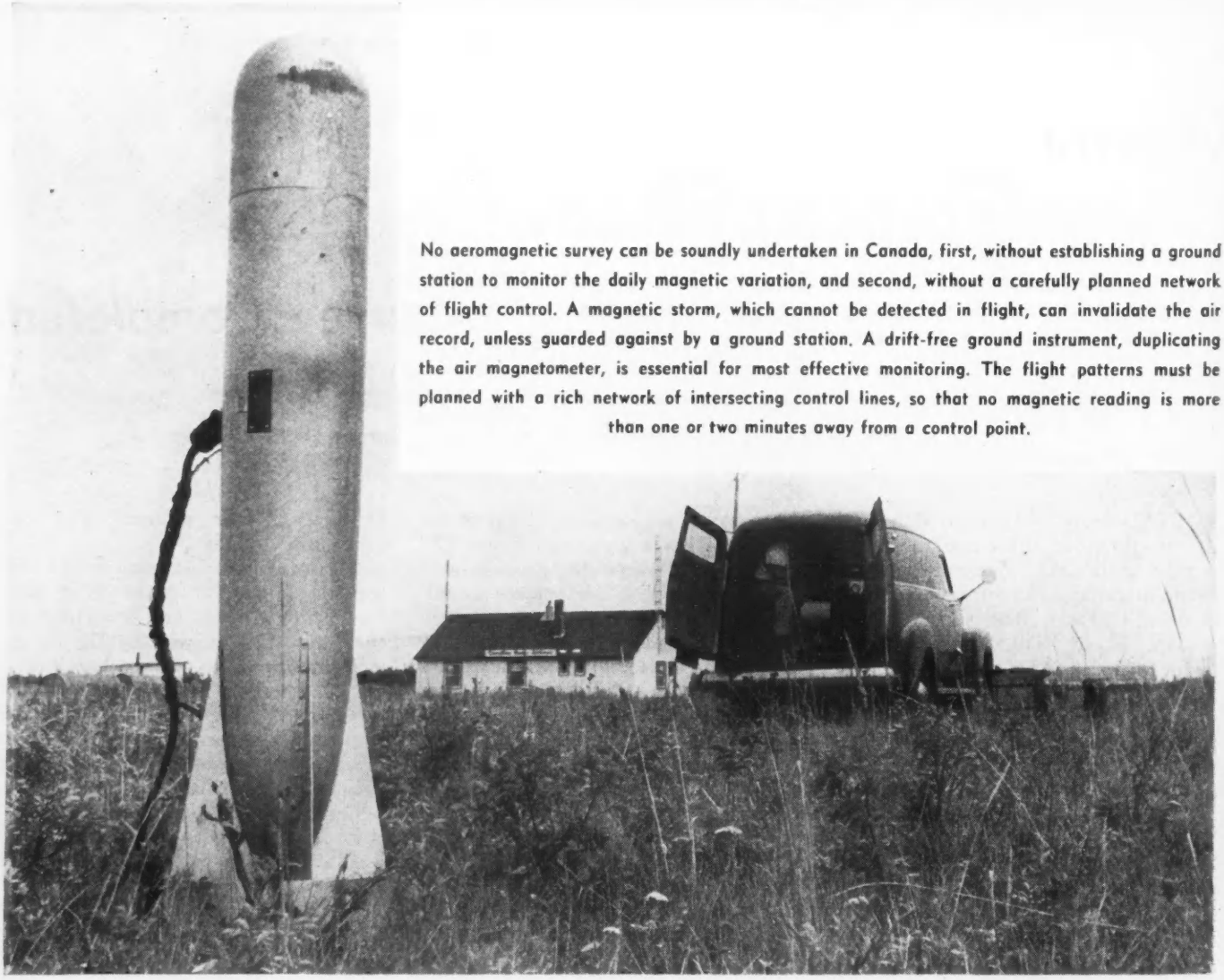
The magnetic intensity maps will provide important geophysical data concerning depths and structures of the basement, as well as significant information as to other characteristics of the rocks underlying the sediments here. This reconnaissance data is expected to be of substantial value in directing ground explorations to areas of prime interest.

Operationally, the survey was routine. Adequate airport facilities were available; radio communications and supplies of aviation gasoline were no problem. Flights were completed on schedule, and in general the survey proceeded as smoothly as though it

Key to the success of the survey is the sensitivity of the magnetometer used. An instrument which refers itself frequently to a standard cell during survey flights should be used. It should be ground-checked at regular intervals with a standardized Helmholtz coil.

Survey schedules will depend to some extent, on the weather. However, airborne magnetometer flights can be made on days too hazy or cloudy for aerial photography. Air surveys move at a rate of 100 miles per hour or better; the mapping plane flies over muskeg or heavily timbered sections as easily as over plains areas. It can work in winter and summer. In the Peace River survey, which covered approximately 10 percent of the Province of Alberta, the field work was done at the rate of more than 1 million acres per week. The compilation of the maps for the entire 16 million acres will be completed before the end of the year, within about seven months after the first flight was made.

No aeromagnetic survey can be soundly undertaken in Canada, first, without establishing a ground station to monitor the daily magnetic variation, and second, without a carefully planned network of flight control. A magnetic storm, which cannot be detected in flight, can invalidate the air record, unless guarded against by a ground station. A drift-free ground instrument, duplicating the air magnetometer, is essential for most effective monitoring. The flight patterns must be planned with a rich network of intersecting control lines, so that no magnetic reading is more than one or two minutes away from a control point.



were being done over the highly developed section-lined country of the American Southwest. In Alberta, as in the Bahamas, Venezuela, and Mozambique, terrain was no problem.

But the magnetic storms common to northern areas were a serious problem. At night they are accompanied by the Northern Lights. During the day, they can be detected only with a monitoring station.

To check on this, a ground magnetometer was maintained in operation which duplicated exactly the highly sensitive instrument in the survey plane. This monitoring station began recording an hour before the plane's take-off. If a storm was occurring, a "Flight canceled" was radioed to the survey crew. If the storm occurred after the survey plane was in the air, it was recalled. Brief, minor magnetic disturbances were also observed by the monitoring station, so that reflights for small areas could be made where necessary. These air and ground records were synchronized with a common radio time signal, so that survey tapes and monitoring tapes could be checked against each other.

The monitoring station itself was installed in a ton-and-a-half truck. It was located each day near the center of the survey area for that day, then moved to a new area for the next day. Since the survey area is bisected by a north-south road, the monitoring truck could be moved readily.

In addition to the monitoring station, a rigid pattern of many intersecting control lines was flown. This was done to correct for the marked, daily variations in magnetic field characteristic of Northwestern Canada. This control pattern divided the survey area into 30-by-50-mile rectangles, along whose periphery an overlapping series of loops were flown. A series of tie-lines were also flown at six-mile intervals, perpendicular to the survey flight lines. Thus, no magnetic record is more than three miles from a control point.

These procedures and the Gulf high sensitivity instrument yielded a continuous magnetic record accurate to within one or two gamma. The final maps were compiled at a contour interval of 5 or 10 gamma, depending upon the local gradient.

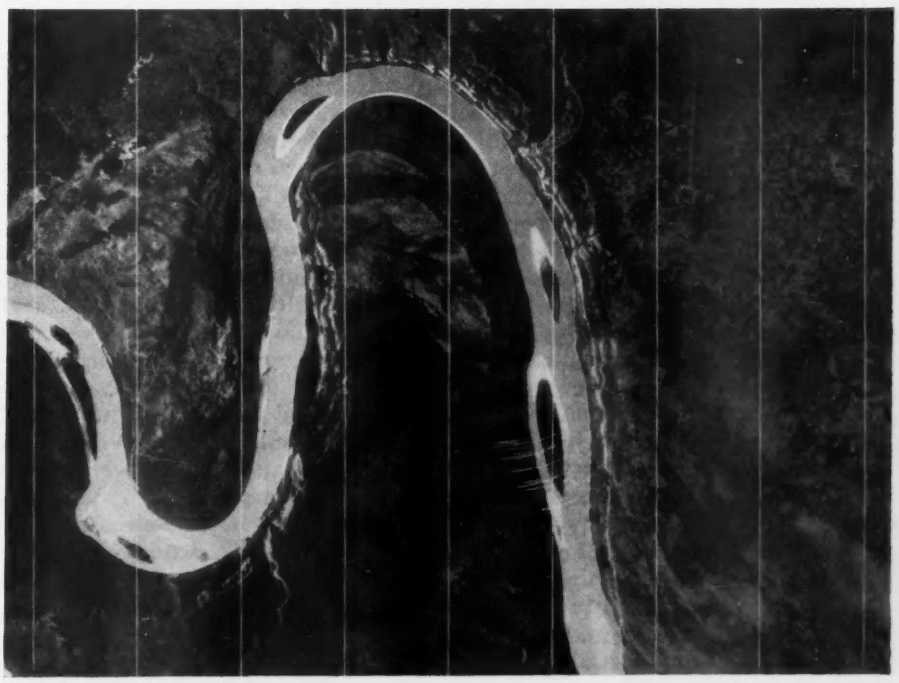
So, within only seven months, the survey was flown and compiled, and aeromagnetics will deliver a valid, regional reconnaissance for these 16 million acres. Analyzed and interpreted by oil company geologists or geophysicists, the data provides a guide to further exploration of this great new area.

## *About the Author*

THOMAS M. O'MALLEY, who heads Canadian Aero Service, Ltd., has been associated with aeromagnetics since 1947. Then chief of the firm's data staff, he directed the compilation of thousands of square miles of aeromagnetic surveys before serving as project engineer for the company's extensive exploration in Mozambique and Union of South Africa in 1949. This year he became president of the newly organized Canadian company, after 14 years in all phases of aerial mapping.

**Survey plane for the Peace River airborne magnetometer study was this sturdy, workhorse craft. The airborne magnetometer is seen in its "cradle" on the underside of the fuselage.**

**Flight-line spacing may be as wide as 1½ to two miles, but seldom greater, for the basement underlying the sediments produces a complex magnetic map whose inflections may be missed at too wide a spacing. There is a tendency to assume that since the airborne magnetometer is a reconnaissance instrument, "let's space widely and get more area." Actually, the spacing should be rather narrower than is usually specified; a one-mile interval between flight-line is best to give a fully detailed map expressing the basement complex. Too wide spacing requires interpolation of the data beyond workable limits; it misses the inflections in the magnetic signature which are so significant in petroleum surveys.**



## KINGDOMS OF OIL

*No. 4*

Photo courtesy The Carter Oil Company

Seminole's muddy Main Street in the late 1920's.

# SEMINOLE, OKLA.

By LLOYD N. UNSELL
IPAA Information Service

WHETHER the petroleum industry's evolution to order should be classed as disappointment or blessing is a matter for conjecture, but these two things are certain: Those Americans who have never seen a real "gusher" very likely never will. And neither will they ever see another "boom town" comparable to Seminole, Okla., in 1926. For Seminole was among the last of the worst — or best — depending on whose judgment is used.

It would be difficult to contrast the Seminole of today, with its wide steets and sprawling, attactive residential areas, against the Seminole of the boom era. Even the oldtimers find it hard to visualize the Seminole of 25 years ago — with its 16-mule teams straining through hip-deep mud with "boiler wagons," the old trucks which often were rescued from the muck by the mules, and the incomparable confusion of this tiny town of general stores and makeshift rooming houses which suddenly found itself catering to a population of nearly 50,000—up from 1500 in a matter of weeks.

It was just at dusk on July 16, 1926, when a horseback rider galloped into town and yelled in Paul Revere fashion that someone had just completed an oil well a couple of miles out. The Seminole City discovery was R. F. Garland and Independent Oil & Gas Company's Fixico—just east of the city.

The Fixico discovery wasn't the first producing well in the Seminole area by any means. Witness to that is Arthur Warner, retired driller of Seminole who drilled in the discovery well Youngblood 1, operated by F. L. Searight. With initial output of 312 barrels daily, the Searight discovery was four miles north of Seminole and preceded the Fixico completion by three months.

"Why, there were nine rigs running on offsets from the Searight well when the Fixico was spudded," recalls Warner, who is still a mite indignant over the acclaim given the latter well.

But no one argues that the Fixico discovery didn't really kick off the boom in Seminole. It flowed 980 barrels of oil on July 17 and increased to 2,680 barrels July 20 after being deepened a foot. That day's report really sold oil men that a major field had been found. It was a Wilcox producer, while the Searight well tapped the Hunton lime pay.

Immediate offsets followed the Fixico completion. Garland and the Independent staked three more on the Fixico lease. Indian Territory Illuminating Oil Company, (now Cities Service Oil Company) staked two tests, Tidal Osage Oil Company. (now Tide Water Associated Oil Company) spotted one and Gypsy Oil Company, (now Gulf Oil Corporation) put in two tests. Four major pipe line companies announced new extensions into the Seminole area. And the boom was under way.

No one who worked in the Seminole field will ever forget its mud. The Rock Island Railroad was the only reliable transportation, and even it had its troubles. Mules and men were called in to upright a badly needed

**THE POPULATION leaped from 1500 to 50,000 in a few weeks. Sometimes the general delivery window at the post office was rushed by 10,000 men during a day. The Rock Island Railroad did more business here in 1927 than in any other city on its entire system, including Chicago. This, then, was Seminole, Okla., a boom town the likes of which we'll never see again; and this is Seminole as it is today, a modern, bustling city with a bright future and a lurid past.**

derailed engine on one occasion. But in 1927 the Rock Island did more business at Seminole than at any other city on its entire system——including that great railroad center, Chicago.

Seminole was literally bursting at the seams in a matter of weeks. No facility was big enough. The post office, manned by three men at the outset, was rushed by as many as 10,000 a day at the "general delivery" window. "Tent towns" sprang up throughout the area. Long, shotgun rooming houses furnished with no more than pot bellied stoves and canvas cots jammed end to end were erected by enterprising individuals who recognized the value of a place to sleep—any place.

That was Seminole, a spot which likely will never again be equalled in the drilling of so many oil wells in so short a time.

Seminole hurried the necessity of state administered conservation in Oklahoma. In 1926, the state produced 177,651,198 barrels of oil, an increase of only 4 million barrels over 1925. But in 1927 the Seminole field spiraled the state's output to 276,022,-024 barrels, a record that still stands.

It was in 1927 that Oklahoma initiated proration. No telling what total production would have been if the lid hadn't been clamped on. During that year, the Seminole field produced 553,000 barrels of oil in one day for an all-time peak—about 80,000 barrels more than all of Oklahoma is now producing under state proration.

To the bewildered onlooker Seminole spelled nothing but mad confusion, but the record drilling activity indicates that most folks knew what they were doing. Some of the most substantial oil firms of today were active in early development of the area — Phillips Petroleum Company, The Pure Oil Company, Deep Rock Oil Corporation, Amerada Petroleum Corporation, Gulf Oil Corporation, Sinclair Oil & Gas Company, and others. Phillips acquired the discovery Fixico lease in 1930 and went on to take a great part in Seminole oil development.

There were many local personalities who indelibly associated with the boom and the subsequent building of Seminole.

Dr. W. E. Grisso who owned the Fixico lease as well as other acreage just as prolific, is one whose energies have meant much to Seminole. Founder of Grisso Royalty Company, he still has wide oil interests. But he also found time to serve on the Oklahoma Highway Commission and was instrumental in bringing to Seminole many of its once-priceless paved roads. Now in his late 70's Dr. Grisso has given freely to agricultural improvement, an interest which claims most of his time.

**Traffic is just as heavy in Seminole now as in 1926 but mud-packed jams have disappeared. The two pictures above were snapped from the same position, covering the Main Street-Broadway intersection. Curious boom-time throng watches lone trucker prepare to winch himself free in the upper scene, snapped in late 1926.**

There were those also who typified the indomitable belief in miracles and undying curiosity which has marked the rise of many an oil man. Some of these never cashed in on the fruits of their works and dreams. Most memorable of these, so far as Seminole was concerned, was the late O. D. Strother, founder of Home State Oil & Gas Company, forerunner of the present Home Stake Companies of Tulsa.

Strother made his first trip into the Seminole Nation, Indian Territory, shortly after the turn of the century. He was a representative of Brown Shoe Company, St. Louis, Mo. Somehow, he had a "hunch" that the Seminole area was oil country. So, in 1906 he moved to Tidmore townsite, in the west edge of what is now Seminole, and began buying leases from Indians and Freedman of the Seminole Nation.

Shortly after statehood, Strother brought a geologist and a small crew to the area, a move which brought back hand whispers from his friends. No one had any faith in "them rock hounds." But Strother kept acquiring

royalty and lease interests. On occasions he was known to have mortgaged all his possessions to carry on. He would visit oil editors of the state's newspapers and take them pecans off his farm in attempts to generate optimistic stories on the "oil potentials" of Seminole.

Ironically, Strother died on March 7, 1926, just when his dreams were about to come true. His death came four months before the discovery on the Fixico lease— which was a diagonal offset to one of the richest quarter-sections in tthe Seminole field, a block known as "Pure Oil Company, Strother 'A' Lease."

A young man who had as much faith as Strother, and who joined the legendary Seminole pioneer in 1926, was F. B. Carden, now president of the Home Stake Companies. As for Strother, he is well remembered in Seminole. A street, a county school, and a public shrine in the Seminole cemetery bear his name.

A very few "lucked" themselves into the oil or royalty business. Take for example the late T. J. (Uncle Tom) McNamara. He ran a small cafe on Seminole's Main street, and was known for his charitable nature. On one occasion, he traded a meal ticket for mineral rights under five worthless acres which turned out to be under the Seminole city discovery block. His first check was in the amount of $16,000.

There were others who got their starts in Seminole in various other forms of enterprise associated with the petroleum industry.

Fred McDuff, whose reflector type signs welcome visitors to Oklahoma at every approach to the state, always managed to supply boilers and drilling equipment when others couldn't. His welcome signs identify him as the world's largest dealer in used rotary drilling equipment. It's a business he started with a desk and a telephone.

Oil field trucking also cuts its teeth in Seminole, although the mule skinners could often guarantee quicker delivery. Forerunners in oil field trucking were O. L. Harvey and S. R. Hazelrigg. Harvey went to Seminole trying to peddle a load of Arkansas peaches. Hazelrigg, a driller, had been injured and was unable to return to field work. So they started the H. & H. Trucking Company, which soon grew to a fleet of 30-odd trucks. The two men now operate separate businesses, but both are still "truckers" in Seminole.

Dr. J. N. Harber, member of a family who has been closely identified with development of Seminole, was another who held much producing interest in the early days. He was also mayor of the town when it was in process of living down a bad reputation. On one memborable occasion, Dr. Harber was the leader of a group of indignant citizens who seized and burned a certain issue of *The Daily Oklahoman* which featured a story on Seminole's disregard for law and order. Harber and others made speeches defending the dignity of the town—while copies of the Oklahoma City newspaper were rounded up and piled on a bonfire in Main street.

Actually, many fabulous rumors and half-truths were spread about Seminole. Dr. Harber, now a resident of Phoenix, Ariz, was the subject of an inspired tale which appeared not too long ago in Walter Winchell's Broadway column. Winchell said Dr. Harber had delivered babies for farmers in return for oil lands, and as a result had become a "billionaire." Most of Dr. Harber's friends agree he would be proud to know he has such wealth.

A part of the history of Seminole is its two banks, the First National and First State. W. Elmer Harber, recently appointed chairman of the reconstruction Finance Corporation, and H. T. Riddle, both of Shawnee, Okla., were early day officers of the former. The First States owes much of its success to Dr. W. E. Grisso, its board chairman, and C. P. Ellis, president. Both banks, on opposite corners, were among the first "brick buildings" in Seminole.

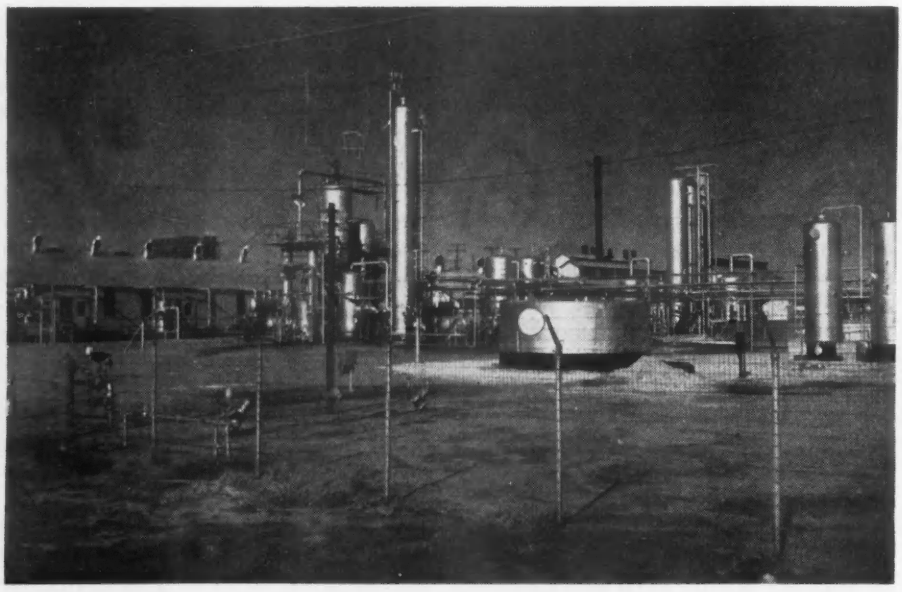
Among significant new progress in Seminole was the paving of two additional blocks on North Main street during the past summer. Some of the oldtimers remarked that "they've finally paved the Alley." This was once the notorious "north end," also known widely as "Bishop's Alley," a locale which simply wasn't considered safe after dark and one with which most folks kept their distance in the daylight. There are a thousand tales of outright violence which occurred there.

Bishop's Alley was the property of W. A. Bishop, early Seminole attorney. It bisected a 40-acre plot which for obvious reasons was kept carefully outside the city limits. And the job of keeping the peace there fell partly to the son of the Alley's owner—Homer Bishop, Seminole barrister who was then county attorney.

Among some of the most memorable of the Alley's frequenters was Pretty Boy Floyd, who died as he lived—in violence. And George Birdwell, a Floyd crony who was killed by a Negro bank teller in an attempted robbery at Boley, Okla. There were others too numerous to mention, some killed in Seminole, some who moved on when the excitement died down, and others who probably will die of old age.

But the occupants of the Alley, with their tents and lean-to, lantern-lit hovels rate little mention here, for they contributed the least of the toil, not to mention the vision, that went into building the Seminole of today. They were simply that perpetual mob —always eager for a fast buck—who followed the gold panners to California and the diamond diggers to Timbuktu.

Those who guarded the peace of



**A landmark in Seminole since shortly after the boom started has been the Grisso gasoline plant of Carter Oil Company, above, just north of the city. The plant has been enlarged considerably since first installation.**

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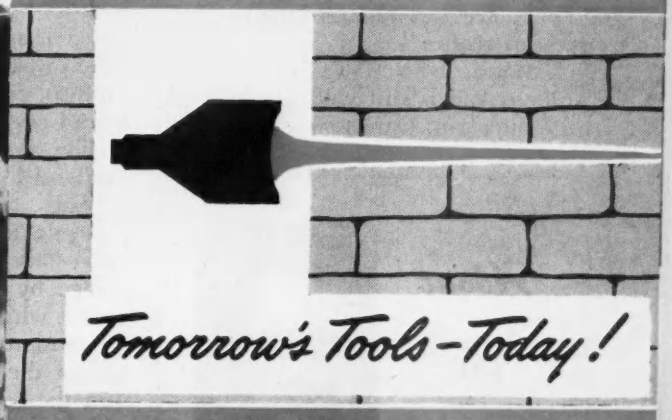


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Seminole against Alley habitues do rate remembrance. No less than five of them died in the effort. At head of the boom time police force was Jake Sims. He recalls cramming as many as 60 various and sundry types of lawbreakers into jail facilities built for 20 — and then chaining more around a tree outside until they could be arraigned before former Justice of the Peace J. W. Fowler. Sims is known as the man who tamed the Alley and the drifters into town, and a curious thing is that he never carried a gun nor drove an automobile. He still doesn't, though until recently he has been chief of the Oklahoma State Crime Bureau, a job he took after 20 years as Seminole police chief.

Seminole bears few scars from the boom. Although it understandably had the benefit of little municipal planning, it has emerged as a well-kept, well-managed city with as much civic pride as any city of 12,000. Its change in appearance from the old days was aptly demonstrated last December 2 when R. F. Garland, operator of the now-famed Fixico discovery, paid a visit to the town for the first time in ten years. In Garland's own words: "The place has changed more than one can realize."

Garland, who now lives in San Antonio and is still wildcatting, took his young son, Dan, to see the site of the Fixico well, which was abandoned in 1935 after producing more than 2 million barrels of oil. The Garlands had to be guided to the site, now marked only by a stone monument which was dedicated by the late Frank Phillips, co-founder of Phillips Petroleum Company, at ceremonies in 1936.

The monument to his discovery, Garland found, is now in the path of a sandy creek which has altered its course through the years, and has almost fallen over from being undermined by high water.

But while the monument gives way to erosion and water runs over the site of the Fixico, the town it started "on the boom" is still growing. Seminole gained a few hundred population in the 1950 census, while Oklahoma as a whole lost more than 100,000. Surrounded by neat oil company residential "camps," it is a town where parking space is at a premium most days of the week.

In the matter of civic life, Seminole has Knife and Fork, Rotary, Lions, Kiwanis, Exchange and a host of other clubs which one would expect to find only in a larger city. It also has one of the most active American Petroleum Institute chapters in the country.

By bond issue, Seminole is now in process of completing a new 32-bed hospital. Church expansion is in evidence on "every other corner." In its religious life, the city boasts 38 churches of all denominations and challenges any other city of comparable size to match its total Sunday attendance.

Regardless of all else, Seminole remains basically an "oil town." Its livewire Chamber of Commerce and its aggressive daily news, *The Seminole Producer,* published by Tom R. and H. Milt Phillips of a pioneer Oklahoma newspaper family, call Seminole the "Oil Field Supply Capital of Oklahoma." There is little argument with this, considering that more of its downtown store space is occupied by oil field supply houses than any other type business. On Main street are the stores of no less than ten of the better known Mid-Continent supply firms.

The continued presence, and occasional expansion, of these supply firms is testimonial to the still aggressive search for oil in the Seminole area. New pools are found each year, and extensions added to those many famous fields developed subsequent to the Seminole discovery—Earlsboro, St. Louis in adjoining Pottawatomie County, Maud, Mission, Carr City, and Bowlegs, the latter immortalized in Edna Ferber's famous novel "Cimarron."

As of this writing, 27 drilling rigs are running in Seminole county, three of them wildcats. And in the five-county area surrounding Seminole, a sector which the town supplies with oil field equipment and services, operators have about 100 rigs in action.

Its civic leaders like to tell you that Seminole has "had its ups and downs, but has never backed up."

As Mayor R. T. (Dick) Harber, oil and royalty operator and nephew of that pioneering mayor mentioned in preceding paragraphs, puts it: "Seminole is going to keep going ahead—because the folks here are interested in seeing that it does."

**Famous Seminole mud. The mud was a little thin in this scene which is a southward view of Seminole's first street in 1926. Rig timbers in foreground were destined for location beyond the swollen "Wewoka creek." Mud-free State Highway 99 now graces this strip.**

## *About the Author*

LLOYD N. UNSELL was reared in Seminole, having moved there during the height of the town's boom era. His first post-high school job was wrenching tubing in the Seminole field. A former newspaper man, his first editorial job was also in Seminole, on *The Producer*. He served 42 months in the Army during World War II, writing for overseas Army newspapers in both Europe and the Pacific. Following the war, he was on the editorial staff of the *Tulsa Daily World* for some time. He has been with the Independent Petroleum Association of America since June, 1948, and now is in charge of IPAA Information Service.

*Sgt. Robert Chrisman levels a field at the eastern end of the Davison airstrip, Ft. Belvoir, Va., with a "Cat" D7 Tractor. In the background are four "Cat" No. 12 Motor Graders completing runway.*

# THE MILITARY GETS FIRST CALL

THESE "Caterpillar" earthmoving machines, working on the runway of the Davison airstrip at Ft. Belvoir, Va., show at a glance where a lot of "Cat" equipment is going these days. And that's how it's got to be.

Defense Rated Orders get first call as America's military establishment prepares for what may come. The urgent build-up of our power has meant drafting machines as well as men. An ever-increasing flow of "Caterpillar" equipment and parts is going to the support of America's fighting men and to defense projects.

This means that there already exists a scarcity of "Cat" equipment and engines for civilian use. So it is to *your* advantage to make the machines you now have *last*. You can keep them on the job longer by doing these things:

**1** **Follow sound and recommended operation and maintenance procedures to the letter. Read and reread your Operator's Instruction Book.**

**2** **Make full use of your "Caterpillar" dealer's facilities for servicing and rebuilding machine parts.**

**3** **Anticipate future parts needs, then contact your dealer and let him help. But *don't* buy or order parts you don't actually need.**

Caterpillar Tractor Co. will do everything possible to maintain every "Caterpillar" machine in the field, to provide new machines as fast as possible, and to allocate them as fairly as possible.

**CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS**

**CATERPILLAR**

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**DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT**

# Of World Oil Men

W. J. LENAHAN, assistant vice president and government relations manager of Trans - Arabian Pipe Line Company, has been awarded the Lebanese Gold Medal of Merit—First Class, by Shaikh Bechara El Khoury, president of Lebanon. The presentation was made in Beirut, Lebanon, in recognition of the part Lenahan played in bringing closer together American business interests and those of Lebanon. Lenahan concluded a convention with the government of Lebanon under the terms of which the Trans-Arabian Pipe Line Company acquired pipe line transit rights across that country and Mediterranean coast shipping terminal near Sidon, Lebanon.

W. J. Lenahan

DR. JOSE MARTARANO BATTISTI'S recent appointment to the newly created position of minister counselor for petroleum affairs at the Venezuelan Embassy in Washington follows a professional career of close association with the petroleum industry.

Specializing in oil following graduation as a civil engineer from the Central University of Venezuela in 1928, Dr. Battisti came to the U. S. in 1939 for a postgraduate course at the University of Tulsa, and was graduated two years later with the degree of petroleum engineer. He was elected a senator to the National Congress in 1943. Shortly afterwards he was appointed chief of the Technical division of oil exploration, refining and transport in the hydrocarbon department of the Ministry of Development.

Dr. Battisti was professor of petroleum engineering at Central University School of Engineering from 1944 to 1947. On leaving the university, he was appointed head of the technical bureau of hydrocarbon in the Ministry of Development. He went to Los Angeles during that year as technical counselor to the Venezuelan delegation at the Petroleum Commission meeting of the International Labor Organization. He was on the Venezuelan commission studying oil conservation in the U. S. in 1948, and later Dr. Battisti went to Sweden to observe the steel industry. Last year he was in London and Washington to study the international oil situation for the Venezuelan government. He also was acting Minister of Development for various periods in 1947, 1948 and 1949.

JAMES W. THOMAS has been elected president of Geophysical Service Incorporated of Nevada, which has taken over the Latin American operations of Geophysical Service Inc. of Delaware. Other officers of the company are Cecil H. Green, board chairman; W. C. Edwards, Jr., vice president; Grant Thomson, secretary; J. E. Jonsson, treasurer; G. J. Kohler, Jr., assistant secretary; and Neil W. Mann, manager in Brazil.

James W. Thomas

Thomas and Mann attended the First South American Petroleum Congress in Montevideo, Uruguay, during the course of a trip to a number of South American countries. Thomas' headquarters are in Mexico, D. F.

BEN F. ZWICK, who for the past two years has been vice president and director in charge of the Canadian operations of Husky Oil & Refining Limited, has resigned. He plans to engage in a private consulting practice in Calgary.

Named to succeed Zwick is Jim C. Gilbert, who has been with the parent firm, Husky Oil Company, at Cody, Wyo.

CANADIAN Gulf Oil Company has appointed R. P. Lockwood exploration manager. Other assignments in the Canadian district include those of P. O. Gassett as exploration manager; O. A. Erdman, chief geologist; R. W. Schweigert, chief scout; P. A. Wilkinson, fiscal advisor; M. A. Mears, taxation advisor; J. A. Fitzpatrick, employee relations advisor; H. A. Fuller, budget advisor; W. G. Combes, supply advisor; and Arch B. Crews, superintendent of Land and Leasing department. Headquarters for these employes are in Calgary, Alberta.

**An "Off The Record" Talk** by Colonel William L. Lee, U. S. Air Force, Commanding Officer, Ellington Field, Houston, was the highlight of a recent meeting of the Houston Chapter of Nomads. Col. Lee informed the Nomads of the problems confronting the industry both in the U. S. and abroad concerning the Russian menace. He also counseled the members of the responsibilities that are theirs in meeting the world emergency. Guests pictured here, left to right, include "Blondie" Roberts, Reed Roller Bit Company, Caracas, Venezuela, Col. Lee, Dean Metts, consulting geologist, Corpus Christi, Texas, and Jeff Tucker, New York City.

*Nationalization Certain*

# Britain Prepares New Bid in Iran

By ROBERT E. SPANN
WORLD OIL Staff

LIKE a nervous fighter awaiting the bell starting the championship bout, British diplomats last month were anxiously seeking final instructions. Their big round is scheduled soon when the Iranian Senate Commission makes its recommendations on the final steps towards nationalizing the properties of Anglo-Iranian Oil Company. This report is expected sometime after the middle of May.

There was little doubt in both diplomatic and Middle East petroleum circles that the nationalization move would be carried out. Despite a pro-western premier in Iran, the influence of the strongly nationalistic political element in the country is considered too powerful for the government to back down on its intentions. The unanimous vote of both houses of Iran's lawmakers on March 15 to nationalize the nation's petroleum industry is considered fully indicative of the feeling in the country.

### Eyes on Russia

Working on this assumption, the only realistic proposals studied in the conference in Washington last month of high-level British Foreign Office representatives and their counterparts in the U. S. State Department were toward what could be done to keep Iran's oil flowing to the western world and out of Russian hands. At best it is believed Iran might be willing to listen to overtures to permit Anglo-Iranian to continue full operation of its oil fields and refineries after nationalization with a division of profits between the government and the company. Shortly after the Iranian vote to nationalize, the British government made an offer to discuss a profit-sharing arrangement. The government of the new premier, Hussein Ala, neither accepted nor declined this offer, but stated it would be willing to listen to Anglo-Iranian officials once the Senate Commission's report was completed.

Meanwhile, chances looked good for a continuation of operations in neighboring Iraq by the American-British-Dutch-French concessionaire. Negotiations between Iraq Petroleum Company and the government of Premier Nuri Pasha Al Said's started following the company's offer made early in April to increase the government's share from Iraqi oil production. This would be similar to the agreement reached last December in Saudi Arabia whereby profits of Arabian American Oil Company after U. S. income taxes are equally divided with King Ibn Saud (WORLD OIL, February 1, 1951).

Despite its position as the oldest and largest oil producing nation in the Middle East, Iran has never fared as well as the governments of other Arab states living off the oil wealth developed by foreign enterprise. While Saudi Arabia and Iraq were able to get offers for a big boost in royalty payments from their concessionaires on comparatively short notices, the haggling over an increase in payments by Anglo-Iranian for its concessions in Iran stretched out for two years. The company in mid-1949 offered to hike its royalty from about 22 cents a barrel to 34 cents a barrel, plus an additional 8 cents a barrel as income taxes. This arrangement would have amounted to the highest royalty then in effect in the Middle East and was tentatively accepted by the Iranian government. This proposal was never ratified by the parliament, and was tossed out early this year prior to the nationalization vote.

The British government, which owns nearly 53 percent of Anglo-Iranian (Burmah Oil Company has a 25 percent interest and the remainder is held by individuals), has taken the view that the company's concession in Iran is valid until 1993 and has promised to carry its claims to the International Court at The Hague. Iran countered by informing the British government that nationalization was an Iranian affair. Western diplomats in their talks with the British have urged that full consideration be given in future dealings with Iran of the great political and economic importance of the nation's oil resources.

Politically, many indications point to closer relations between Iran and Russia. The Communists have been working overtime in their efforts to bring the nation in the Soviet orbit, and should Russia score its greatest military victory—Iran's oil—the impact on the world would be obvious. Besides the loss of the largest supplier to Western Europe at a time when the full oil productive capacity of every producing nation in the Western camp is needed for civilian and military demand, many observers predict the start of a global war would be imminent.

### Economic Status

Despite its leftist political views, the economic condition of the Iranian government could possibly be the avenue of approach for Anglo-Iranian to reach a satisfactory working arrangement for retaining its operations in the country after nationalization is completed. The near-bankrupt government, which earlier this year had to declare martial law to put down striking civil servants demanding overdue wages, already is in debt to Anglo-Iranian from advanced royalties needed to finance its operations. The association of Anglo-Iranian with Iran has always meant the chief source of revenue for the government. Any loss of revenues would spell chaos and obviously would bring Communist agitation for more strikes. The strike by oil field workers that started late in March over the government's request to Anglo-Iranian that it reduce wages to bring them more in line with what is paid Iranians outside the oil company has proven costly to the government and has increased the general unrest. And as time rapidly ran out, it was a matter of speculation whether a strong shot in the arm of the Iranian economy could dispel political ambitions of the Communist-inspired Nationalists.

Elsewhere in the Middle East Syria Petroleum Company notified the

# Now You Can Set these Two S

We realize that your choice of setting method is important, but before we consider the relative advantages of setting methods, let's first analyze the end results obtainable with these tools after they are set.

Among the important advantages of the Baker Retainer Production Packer are its uses . . . for production of one or more zones, simultaneously or separately, for acidizing, for re-pressuring—in fact for every application possible for a packer of its type.

Features which appeal to veteran production men are its Complete Drillability—Resistance to High Temperatures—Corrosion-Resistant Construction—Freedom of the Tubing from the Packer—and Positive Anchoring against Upward or Downward Movement—Bottom-Hole Control with a flapper valve which closes when the tubing is removed, thereby eliminating necessity for killing the well with mud, under normal well conditions.

The wide range of applications, permitting almost unlimited flexibility of subsequent operations, is based upon the construction of the packer itself which employs two sets of opposing slips with a Buna N Rubber packing element between them. When it is set the Packer virtually becomes a part of the casing, cannot be moved up or down, and prevents fluid or gas from passing between the packing element and the casing.

When the Setting Tool (used to set the Packer) is removed from the well, only the smooth-bore Packer remains, securely packed-off, ready for selection and use of the proper Baker Packer Accessory Equipment to meet your production requirements.

It is the extensive line of Accessory Equipment which permits installations to produce from one or more zones, as desired, through tubing or casing—and production changes often can be made without pulling the production string. Complete details of hook-ups, and illustrations of many unique, as well as routine installations, are contained in an 84-page Baker Packer Brochure, gladly sent to you upon request.

**BAKER MODEL "D" RETAINER PRODUCTION PACKER PRODUCT NO. 415-D**

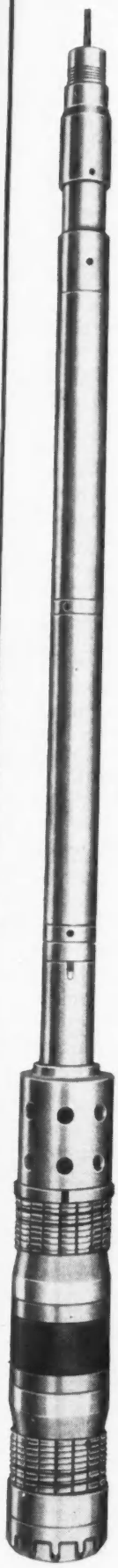
**SET ON TUBING OR A WIRE LINE**

In addition to conventional setting on tubing, the Baker Retainer Production Packer (Product No. 415-D) can be set on an electrical conductor cable by leading service organizations. See listing on opposite page of the organizations in your area, ready to give you prompt, resultful service.

**BAKER OIL TOOLS, INC.**
Houston • Los Angeles • New York

# Baker Retainer Production Packer

# o Successful Tools on a Wire Line



When you select a Bridge Plug, it will pay you to choose the only one that is backed by more than 10,000 successful runs—at every depth—and for every known type of subsequent operation. The Baker Model "K" Retainer Bridge Plug (Product No. 400) is an adaptation of the Baker Cement Retainer, which is too well known to all operators to require any explanation or comment.

In addition to *knowing* that you have selected the most successful Bridge Plug ever developed, you can choose the type exactly suited to your needs: The Cast Iron Type for permanent installations; the Magnesium Alloy Type for temporary service.

Regardless of the size or type of Baker Bridge Plug selected, it will *always* drill out *quickly* and *easily* because *all* Baker Bridge Plugs are *designed* and *constructed* with "drillability" in mind. The very minimum cross-section of material need be drilled up, and even the slips are segmented to break up readily.

You won't need to place cement above a Baker Bridge Plug to obtain a 100% leak-proof pack-off, but you'll be able to place cement there very simply if you desire with the Baker Model "B" Dump Bailer, which is run on a wire line at the same time as the Bridge Plug, when the wire line setting method is used.

After the Baker Bridge Plug is set you can safely proceed with any future operations because it will withstand any pressures you dare impose upon the casing—remain permanently in position—and drill out with no difficulty in record time—every time.

**CAN BE SET ON TUBING OR A WIRE LINE**

The Baker Retainer Bridge Plug can also be run and set on tubing—as thousands have been installed through the years—but to save wear and tear on tubular goods, as well as to save time on deeper settings, any of the leading service organizations listed below can run and set Baker Bridge Plugs on electrical conductor cables. Ask your service company for details—they will give you every cooperation.

**BAKER MODEL "K" RETAINER BRIDGE PLUG PRODUCT NO. 400**

**FOR WIRE LINE SETTING CALL**

**Byron Jackson Co. • Dowell, Inc. • International Cementers, Inc. • Lane-Wells Company • McCullough Tool Co. • Perforating Guns Atlas Corp. • Schlumberger Well Surveying Corp. • Spartan Tool and Service Co. • Welex Jet Services, Inc. • Well Perforators, Inc. • The Western Company.**

# Baker Retainer Bridge Plug

Syrian government it will abandon its concession in the country to take effect next August. The company said it would hand over its property together with accumulated geological information and drilling data to the government. This concession of 41,700 square miles was obtained in 1938 for a 75-year term and in postwar drilling no commercial discoveries of petroleum have been made. Ownership of Syria Pete is the same as Iraq Petroleum—Royal Dutch Shell, Anglo-Iranian and Cie. Francaise des Petroles, each holding a 23.75 percent interest, Standard Oil Company (N. J.) and Socony-Vacuum Oil Company share a 23.75 percent interest and the remaining 5 percent is held by C. S. Gulbenkian, the famous middle-man of Middle Eastern oil.

## Petroleum Products Prices Advanced in Argentina

Maximum prices of a number of petroleum products in Argentina were advanced sharply by the Ministry of Industry and Commerce. The increases, ranging from 32 percent to 75 percent, became effective February 1.

This action was necessary, it was officially stated, to cover the higher costs of imported crude and derivatives, more expensive materials and equipment for the petroleum industry and rising maritime freight rates.

Due to declining crude oil production by Yacimientos Petroliferos Fiscales (YPF), the government-owned oil company, and by private companies that are allowed to operate on a limited basis, Argentina in recent years has had to depend more and more on imports to fill its petroleum requirements. In 1949, for example, imports accounted for more than 60 percent of the nation's consumption, compared with an average of about 40 percent in pre-war years.

The price increases announced by the government agency, as tabulated by the bulletin of The First National Bank of Boston, were:

| PRODUCT | Quantity | M$n* Amt. of Increase | Percent Increase |
|---|---|---|---|
| Gasoline | Per Litre | 1.00 | 66 |
| Fuel Oil | Per Metric Ton | 200.00 | 33 |
| Diesel Oil | Per Metric Ton | 250.000 | 32 |
| Gas Oil | Per Metric Ton | 300.000 | 43 |
| Solvents | Per Litre | 1.00 | 66 |
| Turpentine (Mineral) | Per Litre | 1.00 | 75 |

* Sign for "Moneda Nacional," or paper currency, present dollar exchange value of the peso at official buying rate is $0.20.

Kerosine will continue to be sold at its former price, as will gasoline and other combustibles when used in farm machinery and by transport vehicles of the public services.

# Middle East Output Gains Despite Political Unrest

DESPITE the handicap of operating under a generally uncertain political atmosphere, crude production of concessionaires in the Middle East in the first part of 1951 continued its upward trend. Total daily average output during the first two months of the year approximated 1,850,000 barrels, a little higher than the level at the end of 1950, and nearly 18 percent above the average of 1,560,000 barrels a day in January and February, 1950.

A higher level of production was reported from all principal petroleum nations in the Middle East, though the increases varied considerably. Sharpest increase in crude output during January and February was in Iraq, where, after new government demands for higher royalties, negotiations started early in April toward a profit-sharing plan between Iraq and Iraq Petroleum Company officials. The company's production for the first two months of the year averaged 169,500. Barrels daily, a jump of 49.8 percent over the corresponding part of 1950. Production during February, averaging 170,400 barrels a day, was slightly higher than January's 168,580. In 1950, February production was 112,638 barrels daily, a little under January's 113,600. For all of 1950, Iraqi production of crude averaged about 135,000 barrels daily, a boost of 56 percent over 1949.

A large increase in production also was reported in Kuwait. Total output of Kuwait Oil Company for the first two months of 1951 averaged 397,252 barrels daily, a rise of 46.2 percent over January and February, 1950. Production in Kuwait in February amounted to 358,779 barrels a day, down from the January average of 435,726 barrels daily, but well above a year previous when output amounted to 268,270 barrels a day.

In Saudi Arabia where relations between the government and Arabian American Oil Company were greatly improved late in 1950 with the agreement to share profits of Aramco on a 50-50 basis, after U. S. income taxes, crude production early in 1951 was showing a higher percentage gain over a year earlier than was shown in all of 1950 over 1949. Daily average output for the first two months of 1951 was 597,500 barrels, up 26.1 percent over the January-February period of 1950. Production during January averaged 561,200 barrels daily, up approximately one-quarter over the average of 449,900 barrels a day in the like 1950 month, and February's output rose to 633,718 barrels daily, an increase of 27.6 percent over February, 1950.

Production for all 1950 in Saudi Arabia averaged 547,000 barrels a day, or 14.7 percent above the 1949 daily average. At the end of the year Aramco had production from 95 wells in seven fields, compared with 76 wells on production at the end of 1949.

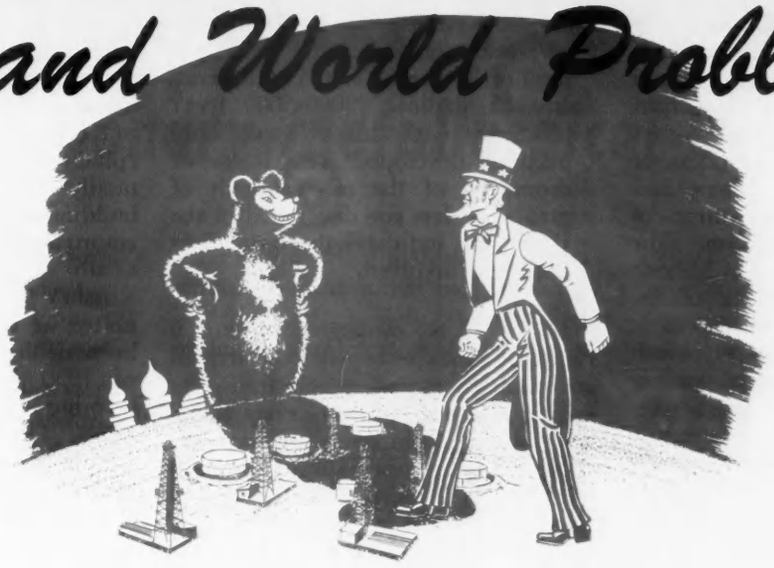
Iran, the largest producing nation in the area and the most troubled by political and labor troubles which together threaten the continued operations of Anglo-Iranian Oil Company, had an increase of 9.9 percent in crude output in January and February over a year ago, a rise from 610,200 barrels a day to 670,400 barrels daily. January production of 643,500 barrels daily was 8.2 percent over a year previous, and output in February, averaging 700,300 barrels daily, was 11.9 percent over February, 1950. Daily average production in Iran for all of 1950 was 661,400 barrels, an increase of 15 percent over 1949.

Production in Egypt and Bahrein during January and February showed only slight increases over the like period of 1950. Daily average output by Anglo-Egyptian Oilfields, Ltd., was 45,700 barrels for the two-month period, compared with 44,200 barrels a day a year previous. Production by Bahrein Petroleum Company during January and February averaged 30,400 barrels daily.

**Middle East Oil Production**
**(Barrels Daily)**

| | 1951 | 1950 | Percent Change |
|---|---|---|---|
| **Iran:** | | | |
| January | 643,500 | 594,700 | + 8.2 |
| February | 700,300 | 625,600 | + 11.9 |
| Two Months Avge. | 670,400 | 610,200 | + 9.9 |
| **Saudi Arabia:** | | | |
| January | 561,200 | 449,900 | + 24.7 |
| February | 633,700 | 496,400 | + 27.6 |
| Two Months Avge. | 597,500 | 473,200 | + 26.1 |
| **Kuwait:** | | | |
| January | 435,700 | 275,000 | + 58.4 |
| February | 358,800 | 268,300 | + 33.7 |
| Two Months Avge. | 397,252 | 271,635 | + 46.2 |
| **Iraq:** | | | |
| January | 168,600 | 113,600 | + 48.4 |
| February | 170,400 | 112,600 | + 51.3 |
| Two Months Avge. | 169,500 | 113,200 | + 49.8 |
| **Egypt:** | | | |
| January | 46,000 | 44,400 | + 3.5 |
| February | 45,500 | 44,000 | + 3.5 |
| Two Months Avge. | 45,700 | 44,200 | + 3.5 |
| **Bahrein:** | | | |
| January | 30,100 | 30,600 | — 1.6 |
| February | 30,600 | 30,300 | + 0.9 |
| Two Months Avge. | 30,400 | 30,300 | + 0.1 |

# Oil and World Problems



By F. JULIUS FOHS

Geologist and Oil Operator, Houston

IN A STUDY for review of a book, by Raj. Narain Gupta of India on "Oil in the Modern World," I was impressed with the difficulty of a layman to understand the world of oil, and the extent to which our free enterprise-democratic system is misunderstood through ignorance and also bias toward "the glorious Russian example" of totalitarianism. I shall attempt to show that oil is the best example of the advantage of free enterprise, particularly as that system is now modified and controlled in the U. S. and as contrasted with the system of Soviet Russia; and discuss the impress of oil on some related world problems.

### Free Enterprise Versus Statism

Under statism there is monolithic control of development from above, while in free enterprise there are "thousands of centers of initiative." In the former there may be the ideal of doing all for the common good, but actually it robs the people of initiative and thereby prevents concentrated thinking and individual planning; where each has a stake in the results, he bends his efforts more forcibly toward accomplishment. In state development, a few individuals at the top give their thought and time because there is personal power, special advancement and special privileges ahead. In private enterprise, in addition to division of effort, there is division of profit but also division of risk. Even with the best technical knowledge the inherent risk of dry holes is still so great that the chance for opening new oil fields and of drilling productive wells is small. In the U. S. where technical and development methods are furthest advanced, one-fifth of the attempts are dry, and in the case of "wildcats" 82 percent were failures in 1950. In that year there were 44,000 wells drilled, a total footage of 159,978,000 feet costing an estimated $1,387,000,000, a prodigious cost for completed wells.

In Russia, a pure state capitalism, the state is both capitalist and entrepreneur. All capital is supplied by the state, which directs development and production and retains profits. Labor receives low wages and is yet heavily taxed. The incentive motive, so generally decried by communism, has to be invoked since human psychology remains unchanged. This is done by giving greater benefits to officials and managers both in cash payments and special privileges (cars and country homes). Labor is stimulated by special awards for increased man-hour output called Stakhanism following the U. S. Taylor plan; it is also forced through a system of fear of imprisonment and forced labor. Slavery is thus practiced under the guise of punishment for political offenses on the largest scale in modern times. Russian reports show that man-hour output still lags greatly. With its imperial plans of world dominion, most of the profits go for military upkeep, part are plowed back for new plant and development. After four of the five-year plans, it is still impossible under their system to develop Russian oil deposits in a reasonable time.

**DESPITE THE claims of nationalized oil industries, the progress resulting from the free enterprise system has never been remotely approached by a state-controlled system. Soviet-Socialism is a good example where lack of incentive represents a lack of progress. With potential reserves in excess of those of the U. S., the Communists have not yet developed a formidable oil producing capacity. The plain facts are that without the wildcatting spirit and free-wheeling enterprise which built the U. S. oil industry Russia never will be a great oil producing nation.**

Were Russia open to private development, capital for drilling sufficient wells would be forthcoming and the people, as a whole, would have greater access to oil products. Their use is now restricted to state officials, limited industry, and principally to the great military machine. Few private automobiles exist. The sale by Soviet Russia in Sweden of an "Opel" model car for a fraction of the price of the German Opel is propaganda, since it is impractical to sell it on a large scale. These cars are needed by the Russian people. The great demand of a self-contained economy for money for governmental, military and all industrial uses, simply does not

permit adequate capital allotment for oil development. The fact that American industry produces and refines daily six times the natural oil output of Russia and its satellites, and causes demand for a daily production of more than 17,000 new cars and trucks, is itself a great source of wealth and activity. The same slow development has been seen in Mexico under state ownership of the oil industry; hence, the recent easement there of development rules to permit foreign investment. This is possible without foreign control; a further relaxation by Mexico would certainly increase Mexican wealth and improve the living conditions of its peon masses.

Russia has four primary basin areas for oil development: (1) Caspian Sea, (2) Pre-Caspian, (3) East Russian and (4) Sakhalin-Kamchatka; also some fair sized basins wholly undeveloped. Among the smaller productive basins are Ferghana in South Central Siberia and Taimyr in North Central (Arctic) Siberia. Lack of adequate development of Soviet Russia's primary areas, and not lack of potential reserves, is the major factor in its failure to produce more oil and gas. My estimates indicate Russia's ultimate potential oil reserves were 1½ times those of the U. S., while her developed reserves are less than one-third of the U. S.; her present potential is more than twice that of the U. S.

Although Russia has built a large scientific and technical staff for the development and operation of oil fields, refineries, etc., the fact remains that she is far behind the U. S. output of oil and gas and this is primarily attributable to the momentum given the U. S. industry by the more than 35,000 companies (whose stockholders number hundreds of thousands and assume broad ownership) as well as a large number of individuals who carry forward such development. Each company, or individual, pinheads particular developments and concentrates thereon.

A study of a single salt dome and the dry holes drilled on it (in this case by four companies) illustrates the great need of capital and concentrated effort:

> At the Bayou Blue salt dome, an area covering six square miles, there have been 66 deep, 69 shallow and 21 deep sidetrack holes drilled covering an estimated 888,000 feet of hole at an estimated cost of $5,200,000 plus $2,325,000 for well completions, a minimum investment of $7,525,000 yielding a total of 35 deep (5000-12,000 feet) and 55 shallow (2000-5000 feet) producers with this field still only partially developed. This is one of thousands of the oil-gas fields of greater or less size developed in the U. S. and indicates the large risks and costs involved.

In the U. S., ownership of the oil rights or lands rests with the federal government, states, corporations, or individuals. The owner receives a royalty ranging from one-eighth to one-sixth and in an especially rich area, it may be even more. Development is done by private companies or individuals (except in the U. S. Naval Reserve of Alaska) and such parties pay the cost and assume the risk. Several owners may join together in a unit operation, a procedure of value to reduce waste, risks, and cost.

### Incentive Benefits

The workers receive high hourly wages and have the general high living standard of most American workers. The federal government, states and schools all receive large sums in taxes—ad valorem, income, excess profit, and personal income tax—based on ownership or profits made, and excise taxes additionally. Through estate or inheritance taxes the federal government and many of the states siphon off much of what a deceased individual has earned and saved in his lifetime. In some instances, individuals have created foundations whose monies, for example, in the Rockefeller and Carnegie Foundations, have done much to advance education, medical knowledge and all branches of natural science and the humanities throughout the world; and among more recent large examples are the Ford, Clayton, Anderson, and Cullen foundations. This return of profits, whether paid in taxes or used by foundations, comes back for the use of the masses. Thus, under the American system, individual initiative is given its greatest incentive and yet the government and the people ultimately get the benefit of the largest area of the profits.

Compared with the average of all industries in 1950, the oil industry retains a somewhat lower percentage of profit and pays 36 percent more income taxes per dollar of sales. U. S. oil industry has an investment of $32 billion. This development has resulted in the building and private ownership of close to 40 million motor cars and trucks, through the related automotive industry. It has caused the building of gas pipe lines across the U. S. to the point where almost 5.95 trillion cubic feet of natural gas are used annually. The use is increasing with the building of additional interstate cross-country pipe lines. There is now practically no waste of either oil or gas. Russia's annual gas output is estimated at 120 billion feet. There had been drilled in the U. S. to the end of 1950 more than 547,000 wells, opening up thousands of oil and gas pools. The average annual use per capita of petroleum products is 593 gallons against 55 gallons in Soviet Russia.

In the U. S., as previously shown, by the imposition of some governmental controls and heavy taxation it has been possible for the government to maintain a major say without stifling private initiative. If these controls and taxation remain reasonable, the U. S. will continue to grow; otherwise, a socialistic state like Britain's will replace the present prosperous American system. By contrast, if we look at Russia, which tends to do everything under a single direction, its oil industry is a perfect example of its inability to develop adequately compared with what private industry could accomplish with the assistance of capital and technology from abroad.

Fascism and Nazism are authoritative totalitarianisms closely related to the state socialism (Stalinism) of Soviet Russia, differing only in that certain political leaders, and sometimes certain capitalists, share directly in the profits.

Almost all the countries of the Middle East continue as feudal states even though some, such as Lebanon, Egypt and Iran, now have parliaments. The present rulers and their descendants control the oil wealth, and together with the rich landowners, are largely in beneficial control of the lands. American, British and Dutch, and some French nationals, together with the British government, have supplied oil development funds; and Iran, Iraq, Saudi Arabia and Kuwait are paid royalties. Recently royalties in Saudi Arabia have been raised to half of the profits, about 50 cents per barrel; in most of the others the rate is 29½ to 31½ cents. The present status in Iran is doubtful due to nationalization since the recent assassination of Premier Razmara. The people of these lands are very poor, and the income from

# DUCTILE IRON

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**DUCTILE IRON** is a cast ferrous product which combines the *process advantages* of cast iron with many of the *product advantages* of cast steel.

No longer in the pilot-plant stage, this new material is now produced and sold on the basis of specifications. Not only are its individual properties exceptional, but no other common engineering material provides such a combination of excellent castability and fluidity, with high strength, toughness, wear resistance, and machinability.

Actually, "ductile iron" denotes not a *single* product, but rather a family of ferrous materials characterized by graphite in the form of spheroids . . . a form controlled, in a broad sense, by small amounts of magnesium. Presence of spheroidal rather than flake graphite gives this new product a ductility that is unique among gray cast irons.

Four important types of ductile iron now being produced commercially are tabulated below.

### REPRESENTATIVE MECHANICAL PROPERTIES OF COMMERCIAL HEATS OF DUCTILE IRON

| | Grade | Tensile strength, psi | Yield strength, psi | Elongation per cent | BHN | Usual condition |
|---|---|---|---|---|---|---|
| A | 90-65-02 | 95/105000 | 70/75000 | 2.5/5.5 | 225/265 | As-cast |
| B | 80-60-05 | 85/95000 | 65/70000 | 5.5/10.0 | 195/225 | As-cast |
| C | 60-45-15 | 65/75000 | 50/60000 | 17.0/23.0 | 140/180 | Annealed |
| D | 80-60-00 | 85/95000 | 65/75000 | 1.0/3.0 | 230/290 | As-cast |

**A** Pearlitic in structure. Provides good mechanical wear resistance.

**B** Pearlitic-ferritic in structure. Provides strength and toughness combined.

**C** A fully ferritic structure usually obtained by short anneal of either (A) or (B). Provides optimum machinability and maximum toughness.

**D** Higher phosphorous content than preceding grades, also higher manganese. Provides high strength and stiffness, but only moderate impact strength.

### SOME UNIQUE PROPERTIES OF DUCTILE IRON

**1.** Its elastic modulus, about 25,000,000 psi, is virtually unaffected by composition or thickness . . .

**2.** It can provide a chilled, carbidic, abrasion-resistant surface supported by a tough ductile core. No other single material can combine these properties . . . its only counterpart being a tough material coated with a hard welded overlay.

**3.** As-cast ductile iron of 93,000 psi tensile strength has the same machinability rating as gray iron with a strength of 45,000 psi.

**4.** Annealed ductile iron can be machined at a rate 2 to 3 times that of good quality gray iron.

**5.** It can be satisfactorily welded.

### APPLICATIONS

Automotive, agricultural implement, railroad and allied industries apply ductile iron, as-cast and heat treated, in components too numerous to detail.

Machinery, machine tools, crankshafts, pumps, compressors, valves and heavy industrial equipment such as rolls and rolling mill housings, utilize its high strength and rigidity.

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Other applications include paper, textile and electrical machinery, marine equipment, and pipe.

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oil royalties has not been used adequately for raising the living standard. A small beginning has been made in Iraq, in Saudi Arabia, and in Iran. Recently, the Shah of Iran made plans to permit use of his lands by the peasants but this is still opposed by other wealthy land owners; the oil royalties, amounting to 30 percent of the national income, are paid into the state treasury.

The nationalization of the oil of Iran does not portend well for the Anglo-Iranian Oil Company, Ltd., which is mostly British government owned. However, it is probable that some terms will have to be made by Iran with the company since the government has no tankers with which to move the oil in international trade. The refinery at Abadan, one of the world's largest, with reported daily output of 600,000 barrels, would otherwise be out of bounds for the western world. The undeveloped area of northern and eastern Iran is to be developed by the Iranian government or its nationals. It is too early to know how far nationalization will benefit Russia; though it is generally conceded to be a great victory for that country.

Russia cannot use Iranian oil immediately and it would be impossible for her to use it for at least three years, the time necessary to build a pipe line over the mountains to the Caspian Sea. She also lacks adequate tankers. If this oil should fall into Russian hands, the whole western world oil development in the Middle East would be outflanked. This might be the forerunner of Russia's complete domination of the Middle East. It is time that Britain and the U. S. reexamine their positions and warn the half-sleeping Middle East overlords of the certain loss of their freedom and property should Russia gain control. Because of the Russian-Iranian mutual defense treaties, no military moves can be made by Britain to protect this great investment without the Russian Army's moving in.

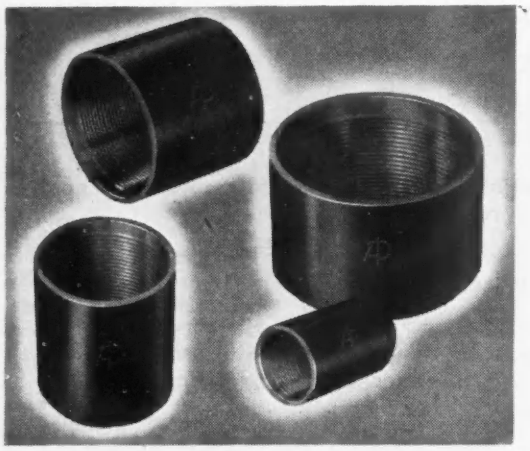
In the remaining two months before the plans for the nationalization mature, some compromise must be found for handling the oil and supplying the technical help to avoid final oil field and military control of Iran by Russia. Loss to Europe of Iranian oil could temporarily be offset by increased Iraqian output through use of the now dormant Iraq-Israel pipe line; and partly by oil from Saudi Arabia, which can easily increase its output.

The maintenance of the present oil developing companies with their capital and technical know-how would appear in the best interests of these countries. With wise application of the royalty funds thus derived much might be done to raise living standards and prevent their falling under communist control, which will otherwise surely happen.

### Oil as a Source of War

Many believe the struggle to control oil deposits a primary cause of war and that both world wars were fought for oil resources as much as for political aggrandisement. It is true that Germany in both World Wars I and II sought governmental and economic control not only of oil but of everything; without those wars Germany would have been today a great world power instead of two fourth-rate states. Neither Britain nor the U. S. has warred to get oil resources, but they will defend their positions and must do so to maintain freedom from aggression.

When once the nations of the Soviet

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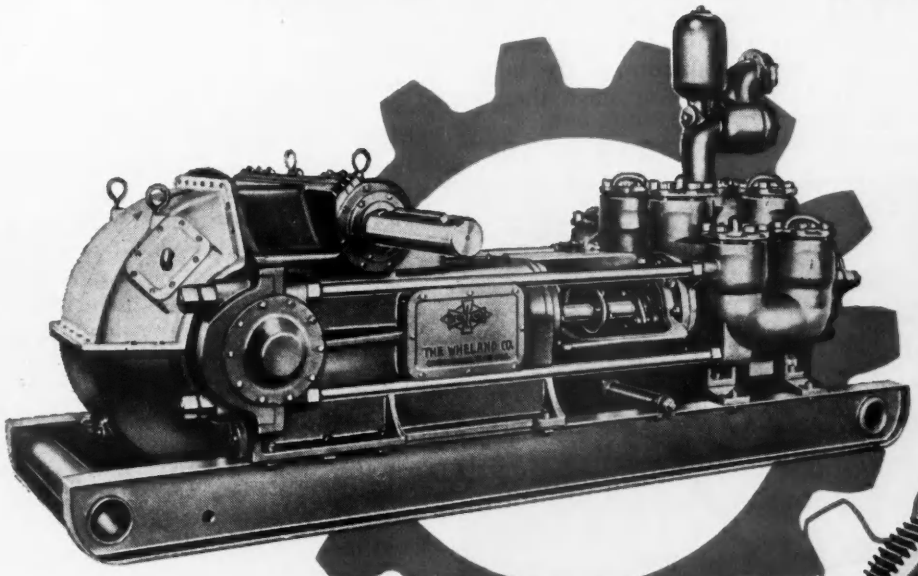

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orbit and the free nations of the world can again sit down together without the draught of world "cold" wars and without the blast of local "hot" wars, it will be possible again to sell freely oil so that all nations may share its use. When this is possible it will be unnecessary for Soviet Russia to attempt to take Middle East oil by force. Such an attempt would be futile, for not only could Middle East oil wells be quickly made unavailable but it would mean destruction by strategic bombing of important Soviet oil fields as well. The geology of northern Iran suggests that the Soviets want it for its strategic and defensive value rather than for its secondary oil possibilities. The large oil distributing corporations of the free world would like nothing better than to deal again with the Soviet bloc, but Soviet Russia's attitude makes this impossible. The U. S. has for years attempted to obtain reciprocal trade agreements between nations with the purpose of a free flow of all commodities.

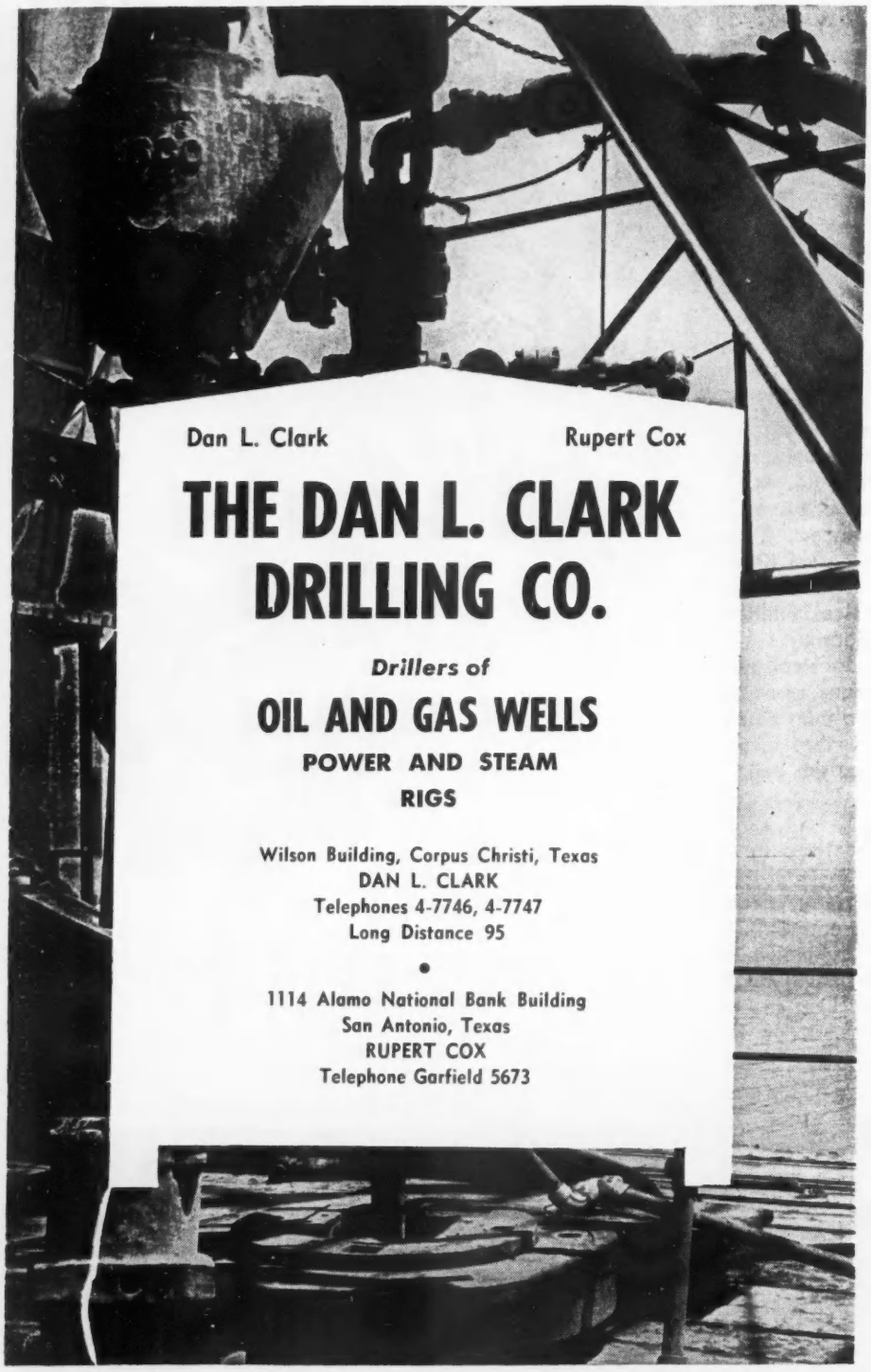
No modern war can be powered without petroleum and its products. The nations that control the larger share in time of war have the advantage over those with limited available supplies, and it was this that conquered Germany in the last war. Russia, with limited output even though it all be concentrated for war use, would be at a disadvantage. If she gains control of any part of the Persian Gulf region the western nations' present advantage will be greatly offset.

Both oil and the nuclear fission and synthesis of the atom necessarily carry potentials for both good and evil. Man has the dual nature of good and evil, and for this reason was supplied with a conscience and choice, and by long experience has established a moral ethnic for right and wrong. However, Communism, Bolshevism and Stalinism have, by following the philosophical teachings of Fuerbach, Marx, Plekhanov, and Lenin, laid the basis for inversion of this moral ethnic by insisting that any means, right or wrong, is proper to follow to advance material ends and obtain power over those resisting their viewpoint of proletarian and collectivist controls over man, man's thought, and resources. As this secular religion is based on unalterable fixed ideas, it will be difficult as long as present leaders are in control of Soviet Russia and its satellites, to reach any dependable decisions in conference with them. It follows therefore that increase of defensive strength by the western nations is the only possible deterrent now at hand. Hence, a choice between a greater and lesser evil in the use of oil and atomic power becomes necessary as part of that defense.

Nationalization and expropriation in Iran, where British nationals spent close to $100 million on oil development and refinery building, if carried through, will make next to impossible a furtherance of President Truman's Point Four program for underdeveloped and underprivileged nations. It is essential therefore that a new plan be devised by democratic nations that will overcome this latest handicap which again gives Russian propaganda a chance to capitalize on the world's ills.

The principle of making war to obtain resources, instead of paying for them by making the necessary investments or by proper contractual arrangements, must be forever outlawed; and it is only Soviet Russia that is now to be feared on this score.

Just as the U. S. Interstate Oil Compact Commission has permitted

# INSIDE INFORMATION

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Ten years of intensive research and more than half a million square miles of practical experience over every corner of the globe has resulted in a magnetometer that is essentially drift-free and has a more rapid response to signal. With greatly increased stability and higher sensitivity, the new magnetometer produces a precise magnetic record, accurate to variations as small as 1 gamma. AERO technicians compile this data in maps reliable to 1 gamma and exact in their correlation with ground positions—the most precise magnetic maps ever produced. These maps' increased accuracy uncovers broader, more certain horizons for worldwide mineral and petroleum explorations.

The airborne magnetometer has truly revolutionized prospecting methods. AERO has successfully delivered important engineering and geologic data from such widely separated localities as Mozambique, Canada, the Bahamas and the Union of South Africa. Today, with the improved Gulf magnetometer, AERO is ready for projected surveys . . . from Arctic wastelands to tropical jungles.

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an equitable allocation of oil production between states and a reduction of waste that is real, so with time it should be possible by treaties between nations to set up an international commission with proper safeguards to prevent its becoming an international cartel, and to prevent its assumption of international sovereignty. This would go a long way toward insuring proper oil supplies for all nations regardless of national ownership, and is another means toward peace and cooperative effort which should ultimately make war undesirable and unprofitable.

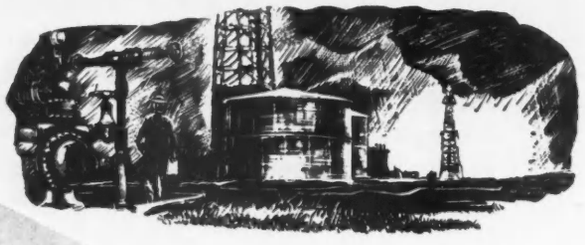
### Synthetic Hydrocarbons Assure the Future

The use of oil and gas necessarily reduces the amount remaining in a country; the U. S. has consumed 36 percent of its ultimate oil reserves but in so doing has developed a great oil-gas industry with its associated petrochemical, automobile, tool and other industries, creating great wealth that benefits all its people. This wealth forms a broad base for the future, so that when the oil and gas reserves have been exhausted, it will be possible to use the know-how obtained for hydrogenizing coal and oil shales to produce both oil and gas products. While not now competitive with the natural resource, synthetics are nevertheless capable of being produced even now at a reasonable cost. This same know-how, together with other chemical and physical advances, will permit ultimate synthesis of oil and gas products from farm and other products. Had the U. S. not derived great wealth from these developments, the research undertaken here, which has greatly advanced knowledge beyond that begun in Germany, would not have been possible. Methods already in sight are ample to care for all future needs.

This is directly in line with the ideas of Sir S. S. Bhatnagar in his introduction to "Oil in the Modern World," in which he says more research in coal and sawdust and the derivation of alcohol from other farm products is the best answer to meet the competition of an oil monopoly (high priced petroleum products) for countries having little or no oil. Actually, the oil companies are selling oil products on a basis relatively cheap when one considers the convenience and ready adaptability of the power produced, and the large investment in development, refining and transportation necessary. This is true because, for the most part, actual competition exists instead of monopoly and attempted world cartels. In the U. S. oil products are still selling on a lower base price per unit than most commodities as a result of efficient technology although prices in some parts of the world may nevertheless still be unduly high. Basing-point prices, because of the large number of barrels per well day output and otherwise low cost, are properly from 90 cents to $1 or more lower in the Persian Gulf region than in the Gulf of Mexico region. A greater factor in retail oil product prices is the excise tax levied by many states and governments, which is in some instances 100 percent.

The advent of oil has greatly advanced man's ability to cover distance quickly and to live a fuller, richer life, and with equal certainty nuclear atomic science will advance mankind; the great technological advances in oil-chemistry and physics helped solve atomic fission and these together with the advances in atomic fission will ultimately permit synthesis of nearly all products necessary to man's existence.


ASK THE ROYAL ABOUT CANADA'S OIL



Branches throughout Canada's oil-rich western plains. On-the-spot information available through J. C. Mayne, Supervisor, Calgary, Alberta, or Head Office, Montreal

*We do not provide information on oil securities*

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Recently made available to the oil industry, Strata-Seal has already proved to be one of the most highly effective, *practical* developments to combat lost circulation and returns.

So effective is Strata-Seal's bridging action, that even in a number of extreme cases, it has restored circulation and saved abandonment of wells.

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# Production Increases Made By Most Firms in Venezuela

VENEZUELAN daily average production was 1,682,535 barrels in the week ending March 26. From all indications, the prediction of Arthur Proudfit, president of Creole Petroleum Corporation, of a daily average of 1,600,000 barrels will soon be fulfilled.

A comparison of 1949 and 1950 daily averages showing how the individual companies fared during the past year, and how they are faring now is given in Table 1.

Most of the companies, particularly the smaller ones, made substantial production gains during 1950, or are making them now. Sinclair Oil and Gas Company's production actually fell off, contrary to the general trend, but oil from Guere field, turned into the pipe line in February, is helping to put the firm back to 1949 levels. Socony-Vacuum Oil Company has gained considerable ground since the beginning of the year, principally through exploitation of the Chimire field. Richmond Petroleum Company's production tends to fluctuate widely, as its only producing field yields a heavy oil of 10-11-degree API for which the market is limited and seasonally unsteady.

Eighty-seven rigs were active in Venezuela in early March, representing a gain of five over the previous month. Of this total, 68 were drilling exploitation wells and 19 were engaged in exploratory drilling.

## Notes

The only major wildcat testing in Western Venezuela in early March was British Controlled Oilfield's EM-285, about 14,000 feet, on the east side of Lake Maracaibo, in an area where deep horizons have never been explored. Atlantic Refining Company abandoned Guasare 1, testing at 14,460 feet since last July, and Shell gave up on DPE-1, also a Cretaceous test northwest of the Mara field, bottomed at 11,231 feet. Drilling continued below 9000 feet on Shell's CQ-1, in the mountains near Valera, and at about 1500 feet on its La Concepcion C-149, a Cretaceous test. (The first limestone well in this otherwise relatively shallow field was C-148, completed in 1948 for an initial potential of 1800 barrels per day.)

In Guarico, Atlantic abandoned Monal 1 at 6000 feet. Atlantic has a rank wildcat, Anibal 1, scheduled for southeast Guarico, in which Socony will participate. They will also soon resume operations on Guama 1, north of the Taman field. This wildcat, in which Shell is a partner, was suspended at about 8000 feet last August, after a fishing job, a fire, and a flood, successively, complicated the work of running casing.

In Eastern Venezuela, Mene Grande successfully completed Cerro Pelado 1-A at 5634 feet but abandoned Chipo 1, Macuare 1, and Jonote 1, at 9904, 9574 and 8709 feet respectively. This company's vigorous exploratory program continues, with Chaparro 1, Boca 1 and East Soto 1 making hole as March began. The Texas Company abandoned Mata 1, sidetracked at about 12,000 feet, and spudded Mata 2 at a location to the west. Creole continued drilling at West Maron 1, nearing 11,000 feet.

Creole's Guanoco 1 is the latest in a long series of attempts to find oil production near the Guanoco asphalt lake of Eastern Venezuela. A million and a half tons of asphalt were taken out between 1891 and 1935 by the New York & Bermudez Company.

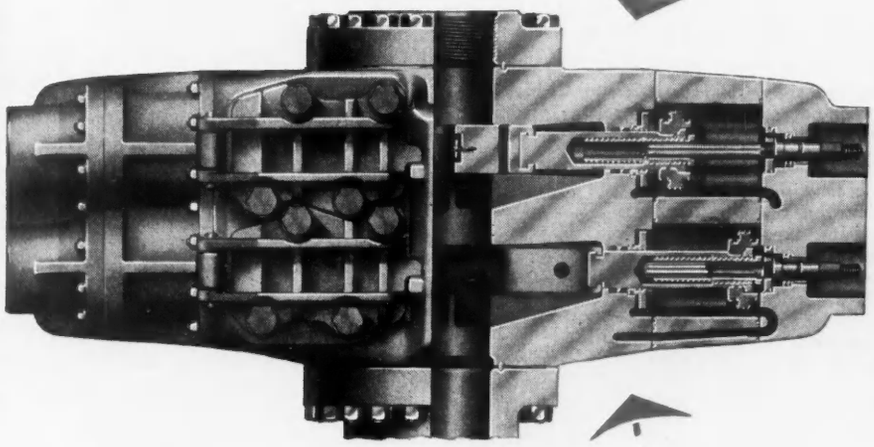
**TABLE 1**

| COMPANY | Daily Average, 1950 | Daily Average, 1949 | Increase or Decrease | Percent | Week Ending March 19 |
|---|---|---|---|---|---|
| Richmond | 12,500 | 3,837 | + 8,663 | 225.7 | 15,651 |
| Ven. Atlantic | 21,009 | 11,700 | + 9,309 | 79.6 | 21,373 |
| Phillips | 7,493 | 4,855 | + 2,638 | 54.3 | 6,065 |
| Pantepec | 12,318 | 8,685 | + 3,633 | 41.8 | 10,620 |
| Mene Grande | 243,300 | 211,919 | + 31,381 | 14.8 | 294,241 |
| Texas-Mercedes | 44,416 | 39,091 | + 5,325 | 13.6 | 46,603 |
| Shell | 461,711 | 409,984 | + 51,727 | 12.6 | 504,022 |
| Creole | 644,751 | 579,367 | + 65,384 | 11.3 | 710,797 |
| Socony | 36,907 | 35,878 | + 1,029 | 3.0 | 47,036 |
| British Controlled Oilfields | 1,009 | 1,064 | — 55 | 5.1 | 914 |
| Sinclair | 12,598 | 15,190 | — 2,592 | 17.1 | 15,291 |
| Industry Total | 1,498,012 | 1,321,620 | + 176,392 | 13.3 | 1,672,613 |

# In the Shaffer Hydraulic Cellar Control Gate

## ALL MOVING PARTS ARE COMPLETELY ENCLOSED!

**Take a look at the clean design of the new Shaffer Hydraulic Cellar Control Gate. Note how all operating parts are COMPLETELY ENCLOSED within the body of the Gate.**



**1** There are no outside moving parts to become corroded by chemical muds or salt fluids dripping into the cellar!

**2** There is nothing to become wedged or jammed by falling objects or loose timbers in the cellar!

**3** There are no exposed shafts where mud and grit can collect to be carried into packing units, score shafts, cause leakage and early failure!

- **No corrosion problems from chemical muds!**
- **No jamming or wedging by loose objects!**
- **Greater protection—greater safety —less maintenance!**

In fact, not only are all moving parts protected within the body of the Shaffer Hydraulic Cellar Control Gate, but even the locking shaft is non-rising and completely protected at all times!

***What do these features mean?*** Simply this—that Shaffer engineers have designed the Shaffer Hydraulic Cellar Control Gate to be safety equipment *of the most advanced type*—with no operating parts exposed to the severe conditions and unpredictable elements found in rig cellars.

Nothing is left to chance. When pressure emergencies occur you can depend on this unit being ready for *fast* and *complete* closure without interference from any foreign material or objects outside the body—*because they simply cannot interfere with its operation!*

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## And Don't Forget These 4 Other Vital Features, Too!

Complete protection of the operating parts is only one of many important features found in the Shaffer Hydraulic Cellar Control Gate. These are equally important—

▶ **SPACE SAVING COMPACTNESS:** Although *two* separate ram compartments are unitized in *one* body, the overall height of the Gate, including both compartments, is only 30" in sizes as large as 13⅜" (12" Series 900). Smaller sizes even less!

▶ **SIMPLE RAM CHANGES**—the simplest in *any* Gate. Just unbolt and swing open a side door, slide out the ram assembly, slide in the new assembly, close and bolt the door. It's as simple as that—*and complete ram changes can be made whether pipe is in or out of the hole!*

▶ **QUICK DRAINING BODY:** The rams travel on high narrow guide ribs raised above the steeply-sloped bottoms of the ram compartments. Mud and sand quickly drain back into the well—no detrimental accumulations to interfere with free ram operation!

▶ **DIRECT HYDRAULIC DRIVE:** Hydraulic operating cylinders are *directly behind* the rams for direct action, maximum simplicity, greatest safety. No secondary connections between hydraulic cylinders and rams!

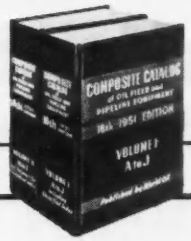
And there are still other important features—all combining to make the Shaffer Hydraulic Cellar Control Gate the most advanced *hydraulic* gate available today. Get full details from your Shaffer representative —or write direct!

**Write for the new 1950 Shaffer Catalog that gives full information on the Shaffer Hydraulic Cellar Control Gate as well as other Shaffer products.**

**See pages 4433 to 4496 of your 1950 Composite Catalog!**

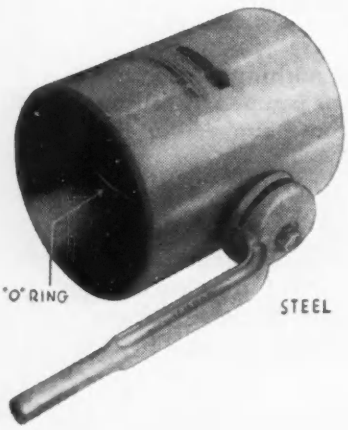
# NEW AND IMPROVED EQUIPMENT

## SUPPLEMENTING COMPOSITE CATALOG




## Butterfly Valve

**This item supplements Mud Products, Inc., data on pages 3492-3493 of Composite Catalog, 18th Edition.**



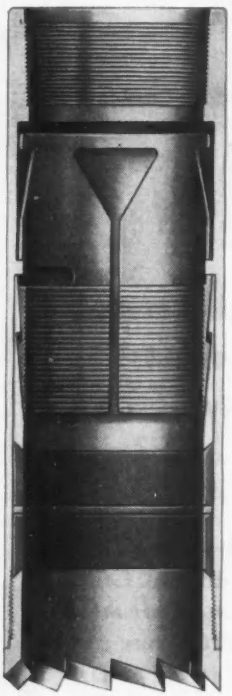
The Mudco O-ring butterfly valve for use in salt water disposal systems, rotary mud systems, production and plant operations, provides effective closure at 125 pounds water pressure, or under vacuum. For highly corrosive conditions, all aluminum-bronze valves are available in 2-, 3-, 4-, 5-, and 6-inch sizes. To operate the valve, the lever handle is turned to the open or closed positions, regardless of pressure.

The valve, which utilizes the O-ring principle used in aircraft hydraulic systems during World War II, when being closed sweeps solid materials such as shale and other foreign matter out of the way. It thereby offers a greater chance of positive closure than obtainable with conventional gate-type valves. In shop tests, according to the manufacturer, the valve has been opened and closed 3000 times under pressure from drilling mud without affecting the efficiency of the seal. Under clean water pressure, it has been opened and closed well over 8000 times without leakage. When leakage does develop, the sealing effectiveness is restored by replacing the worn O-ring with a new one. Extremely lightweight, the six-inch Mudco valve (screwed) weighs only 29 pounds, as compared to 155 pounds for a six-inch screwed conventional valve.

For additional information, write Mud Products, Inc., Philtower Building, Tulsa.

## Releasing Casing Bowl

**This item supplements S. R. Bowen Company data on pages 781-820 of Composite Catalog, 18th Edition.**



The new packer type Bowen releasing casing bowl is for use in wells where casing difficulties are encountered. The standard procedure is to make a cut with an internal cutter in the casing immediately below the damaged area and to pull the casing from the hole. The damaged portion of the casing string is then replaced with good casing. A packer type releasing casing bowl is then installed on the bottom end and lowered over the casing into the hole. When upward pull is exerted, the tapers on the cone contract the slips into secure engagement with the casing and the cone bears against and compresses the lead packing into a leak-proof seal around the casing.

The bore of the tool is always either the same or larger than the inside diameter of the casing on which it is run so that there is no impairment of any inside-the-casing operations.

Should hole conditions prevent a perfect pack-off, the tool can be released and the casing again withdrawn without the expense of making an additional cut with an internal cutter. After the necessary corrections have been made, the tool can again be run in the hole and engaged with the casing. If the well is to be abandoned shortly after the tool is set, the casing can be salvaged above the casing bowl.

Release is effected by bumping down and rotating to the right. This hangs the slip in its uppermost position. In this position, the slip cannot be contracted against the casing by the tapers on the cone, and the tool can easily be withdrawn.

For additional information, write S. R. Bowen Company, P. O. Box 427, 11008 South Norwalk Boulevard, Santa Fe Springs, Calif.

## Scratcher

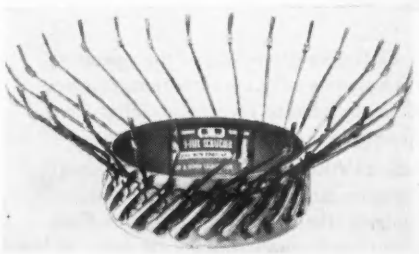
**This item supplements B and W Incorporated data on pages 457-462 of Composite Catalog, 18th Edition.**

A new scratcher construction provides protection for the mud cake and increased area for return circulation while the casing is run into the hole. An effective scratching action for removal of mud cake from the formation in the cementing zone after casing reaches bottom is also claimed for B and W Multi-Flex Scratchers.

The "upswept" flexible construction of the multiple wire scratching fingers permits them to point upward as the casing is run so that they do not dig into the mud cake or form an obstruction to impede return circulation. Thus, casing equipped with Multi-Flex scratchers can be run to the cementing depth without hazardous and time-consuming delays for circulating and mud conditioning, and when the casing reaches bottom circulation can be established with normal pump pressure.

When the casing has been run to the landing point and is worked up and down the spring units reverse and dig sharply into the mud cake, breaking it into small fragments that are easily circulated out of the hole. It is recommended that the casing be moved as soon as possible after reaching bottom and that mud cake be removed gradually by increasing the length of stroke during the circulation period from an initial length of two or three feet to a final length that is greater than the spacing of Multi-Flex scratchers on the casing.

For additional information write B and W Incorporated, P. O. Box 5266, Houston 12; or 3545 Cedar Avenue, Long Beach 7, Calif.



### Save Time—Write Direct

**As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.**

REFLECTIONS . . . show the extreme accuracy of honing which gives mirror finish to "Oilwell" DI-HARD LINERS.

# DI-HARD . . . your best buy in Slush Pump Liners!

## *BEST...by field test!*

"OILWELL" engineers have completed a series of liner field tests which add evidence to the contention that abrasion resistance results from low coefficient of friction as well as from surface finish and hardness.

In "Oilwell" No. 14P-HD and No. 20-P duplex power pumps, DI-HARD liners were placed in one side while induction hardened companion liners (of corresponding 60-67 hardness range on the Rockwell "C" scale) were used in the opposite side.

The tests (three for each pump size) were made on pumps in regular field service . . . under as wide a range of drilling conditions as possible. In ALL SIX TESTS, the "Oilwell" DI-HARD liners out-performed induction hardened liners. Your "Oilwell" Representative has all the facts and will gladly give you the details.

### CONCLUSION:

Since the hardness and mirror finish of both DI-HARD and these induction hardened liners were practically identical, it becomes evident that the ability of metal to resist wear and corrosion is dependent upon other factors as well as hardness.

DI-HARD has the lowest coefficient of friction of any known metal suitable for liner applications and is more resistant to wear by a corresponding degree. If you are using any other liners in your "Oilwell" pumps, switch to DI-HARD and learn for yourself how much "extra service" they give.

***ASK . . . your "Oilwell" Representative for your copy of our recent Slush Pump Fluid End Parts booklet . . . and keep your "Oilwell" pumps "OILWELL" for outstanding service.***

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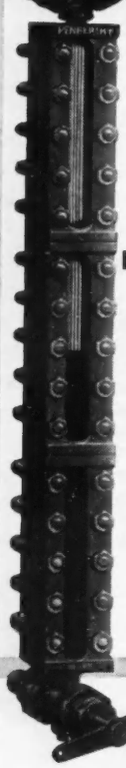
USS TRADE MARK

"OILWELL" TRADE MARK

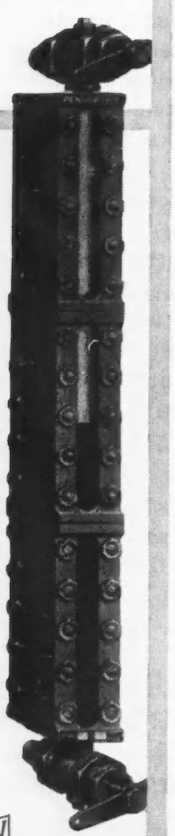
UNITED STATES STEEL

PENBERTHY
REFLEX and TRANSPARENT
DROP FORGED STEEL LIQUID LEVEL GAGES



PENBERTHY
REFLEX
Drop Forged Steel
Liquid Level Gage
Empty Space Shows White
Liquid Shows Black

Due to "Reflex" principle, liquid always shows black and empty space white. Liquid level is indicated instantly and unmistakably. Made of temperature resisting alloy steel for high pressure and temperature service. Conforms with API and ASME requirements.



PENBERTHY
TRANSPARENT
Drop Forged Steel
Liquid Level
GAGES

Glass front and rear permits observation of color and density of liquids under high pressures and/or temperatures. Highest quality—made of temperature resisting alloy steel. Conforms with API and ASME requirements.

3277-C

PENBERTHY PRODUCTS

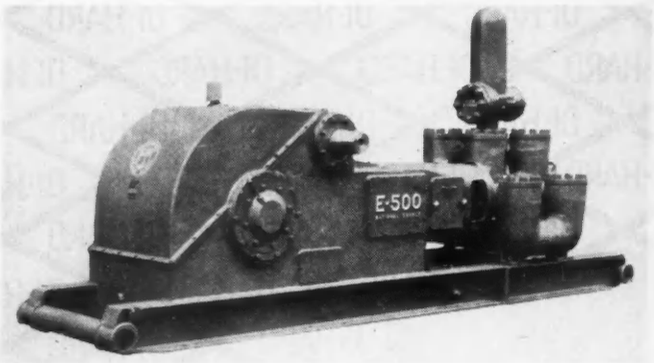
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

# NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

## Power Slush Pump

**This item supplements The National Supply Company data on pages 3501-3632 of Composite Catalog, 18th Edition.**




A new power slush pump, the Ideal Type E-500, has 7¾-inch maximum fluid cylinder liner bore, 14-inch stroke, and is rated at 500 hydraulic horsepower output at 70 RPM.

The pump incorporates a fabricated power end similar to that used on the Ideal Type E-700 Pump. This construction permits a relatively low weight per horsepower factor. The new pump weighs approximately 38,000 pounds. The E-500 can be used with existing rigs to replace smaller pumps when greater pump capacity is required.

The pump frame is of unitized construction, combining steel plate and steel castings welded into one unit. The fluid end is a one-piece steel casting without internal baffles or walls. For immediate detection of liner packing leakage, "telltale" holes are provided. Improved fluid cylinder liner construction with O-ring packing eliminates liner set screws.

The Type E-500 pump utilizes a splash system of lubrication for the main gear, pinion and crossheads. Oil from the meshing of the main gear and pinion is caught in a trough and cascaded over the crossheads to provide lubrication for the crosshead bearings and guides, and is returned to the sump. The sump is provided with a convenient oil level indicator and an easily accessible cleanout plate with a magnetic drain plug at its lowest point.

For additional information, write The National Supply Company, Box 899A, Toledo, Ohio.

## Protector Equipment

**This item supplements Patterson-Ballagh, Division of Byron Jackson Company, data on pages 4109-4152 of Composite Catalog, 18th Edition.**

New light-weight equipment enables casing and drill pipe protectors to be installed quickly and, on the rack, with a minimum of handling. When protectors are installed while making a trip, the PB equipment installs them on each joint in the stand without extra breaks to install protector on middle and top joints.

Using the hydraulic installation unit, the PB drill pipe protector may be quickly installed on the transfer sleeve. Several transfer sleeves may be kept loaded with protectors and ready for immediate installation onto the drill pipe. The unit has a gasoline engine and pump as a power source, but is also available to utilize any other source of hydraulic pressure at the rig.

The hydraulic push-off tool speeds the transfer of the protector from sleeve to drill pipe. This tool is operated by a foot- or hand-operated pump. It is entirely automatic. Removal of protector from sleeve to drill pipe is accomplished by three strokes of the pump.

The equipment allows protectors to be installed on drill pipe going into or coming out of the hole, or on the racks, at the yard or the rig.

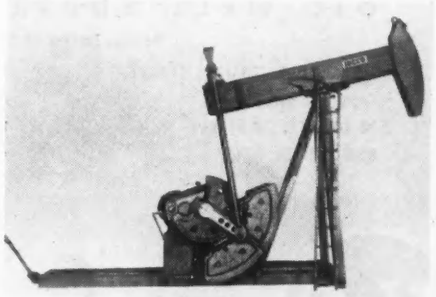
For additional information, write Patterson-Ballagh, P. O. Box 2493 Terminal Annex, Los Angeles 54.

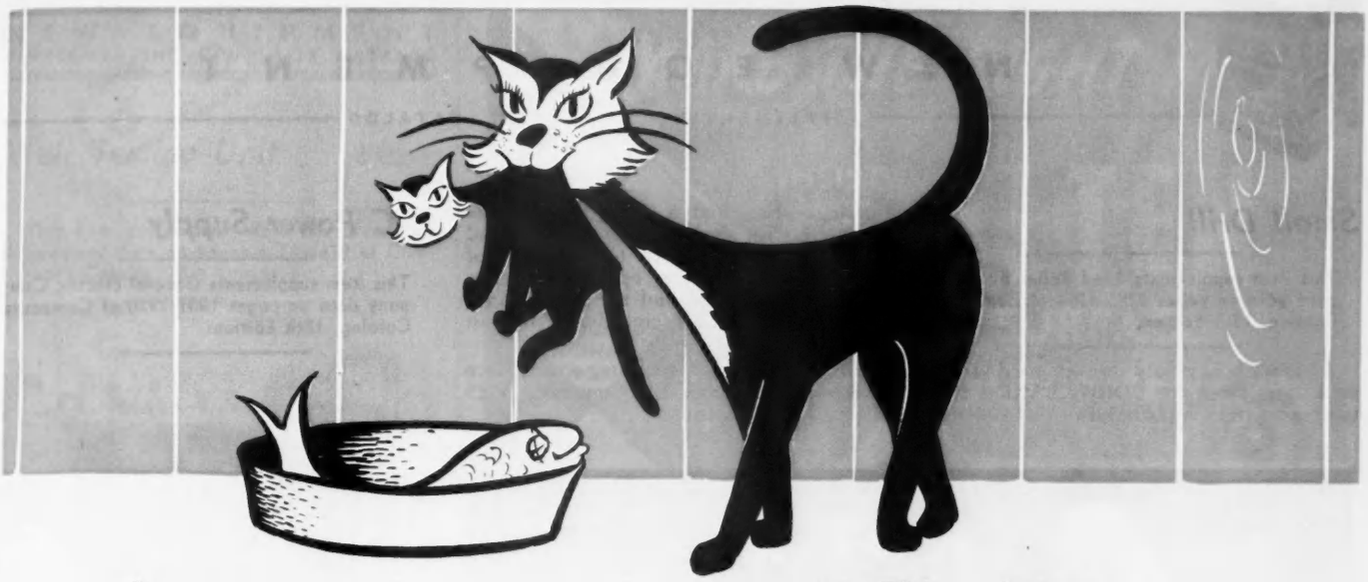
## Pumping Unit

**This item supplements International Derrick & Equipment Company data on pages 2497-2572 of Composite Catalog, 18th Edition.**

The F12-DA114 pumping unit has polished rod load capacity of 11,600 pounds and is fitted with a double reduction herringbone geared speed reducer with an API peak torque capacity of 114,000 inch pounds. Its Ideco wheel-type counterbalanced crank has a maximum stroke of 54 inches. The unit has rigid four-leg samson post, welded sub-base under the speed reducer, and shock-proof pitman equalizer assembly. All shafts are carried on roller bearings. Lubricant is filtered with the magnetic oil sump and labyrinth seals on all shaft extensions.

For additional information, write International Derrick & Equipment Company, P. O. Box 1331, Dallas 1.

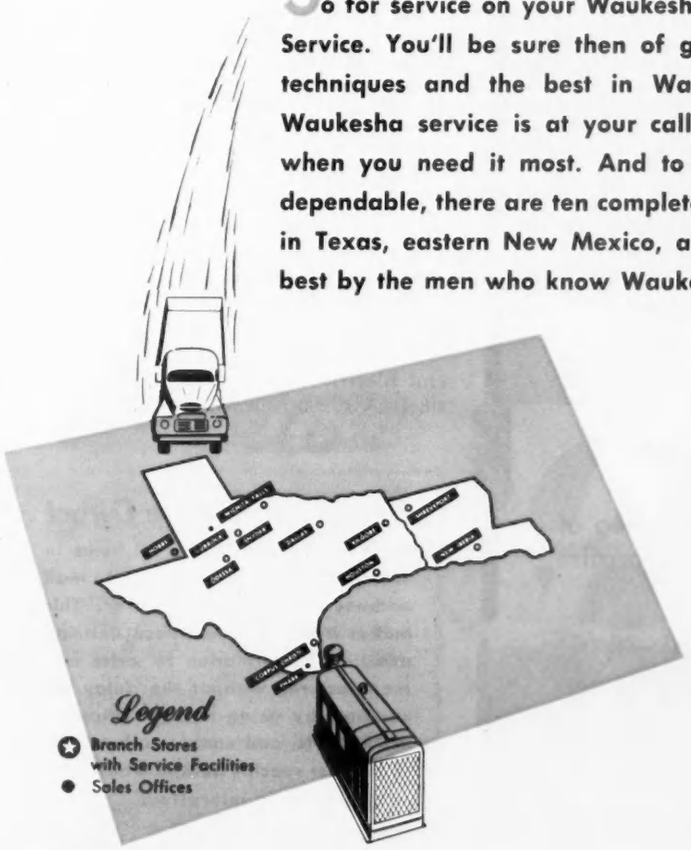




# YOU'RE TREATED BEST AT HOME

## YOUR *Waukesha* ENGINE IS TREATED BEST AT HOME, TOO

So for service on your Waukesha Engine call Waukesha Sales and Service. You'll be sure then of getting the latest in factory-service techniques and the best in Waukesha factory-trained mechanics. Waukesha service is at your call twenty-four hours a day to help when you need it most. And to make Waukesha service fast and dependable, there are ten complete service shops strategically located in Texas, eastern New Mexico, and Louisiana. You will be treated best by the men who know Waukesha best.

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## SALES & SERVICE, INC.

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EXCLUSIVE DISTRIBUTORS FOR WAUKESHA PRODUCTS IN TEXAS, LOUISIANA AND EASTERN NEW MEXICO

# NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

## Small Drill

**This item supplements Reed Roller Bit Company data on pages 4285-4364 of Composite Catalog, 18th Edition.**

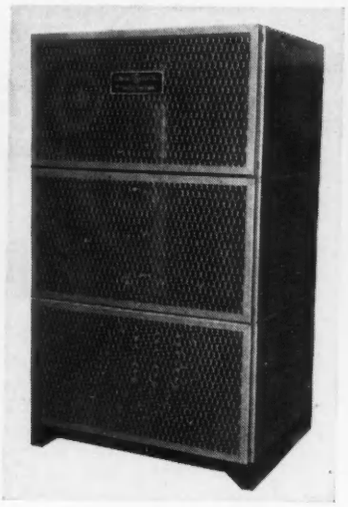
A new heavy-duty air-operated small drill, designated the 9DBW-28A, has stub tooth gear train, built-in lubricator, a sealed spindle bearing and a chuck guard. The small size, 5¾ inches long over-all, and 13/16 inch from the side to the center of the spindle, permits easy operation in close quarters. High speed and the maintenance of speed under load contributes to fast drilling.

For additional information, write Cleco Division, Red Roller Bit Company, 5125 Clinton Drive, Houston.

NOT A
GHOST OF
A CHANCE!
Paraffin congestion in pumping wells? NOT A CHANCE—with S-I-W M-25 paraffin scrapers! As a result of research and field experience the Sunshine Iron Works has engineered a new and better paraffin scraper for pumping wells. Our M-25 Features: (1) EFFICIENCY — two heavy blades spiralled and welded around shell halves exert a continuous unplugging effect in the hole as they curl off the paraffin with every stroke, (2) STRENGTH — the M-25 gets a real grip on the rod, (up to 5,000 lbs. by test) and stays put, (3) WEARABILITY — heavier construction assures long dependable operating performance, (4) EASY FIELD INSTALLATION — M-25's are easily and quickly installed on the spot. Order a supply today.
• NEW DESIGN
• GRIP OF STEEL
• LONGER WEARING
Write for complete catalog of Sunshine Iron Works Paraffin control equipment.
Sunshine Iron Works
PHONE 4374
601 W. MURPHY
ODESSA, TEXAS


## D-C Power Supply

**This item supplements General Electric Company data on pages 1901-1920 of Composite Catalog, 18th Edition.**



A new line of standard, metal-enclosed d-c power supplies utilizing selenium rectifier stacks applicable wherever d-c power is required may be used for excitation of synchronous motors; operation of d-c elevators, cranes and machine tools; and for conversion of a-c feeders to d-c.

Designed for indoor installation, the rectifier units are mounted in a metal casing consisting of one to four separate sections, mounted vertically, one on top of the other, and bolted together. A removable front, wire-mesh panel permits easy access to all component parts.

The new units supply either 125 or 250 volts d-c from a 208-, 230-, or 460-volts, three phase, 60 cycle a-c supply. Convention-cooled equipments are available in ratings of 0.75, 1.5, 3, and 5 kw. Fan-cooled units are rated at 7.5, 10, 12.5, 15, 18.5, 20, and 25 kw.

For additional information, write General Electric Company, Lighting and Rectifier divisions, Schenectady 5, N. Y.

### Save Time—Write Direct

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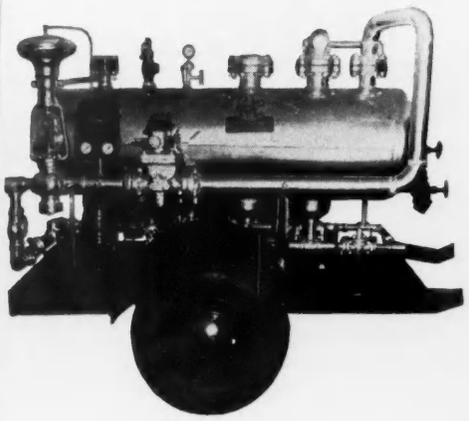
## NEW EQUIPMENT
SUPPLEMENTING COMPOSITE CATALOG

### *Well Testing Unit*

**This item supplements Rolo Manufacturing Company data on pages 4418-4419 of Composite Catalog, 18th Edition.**

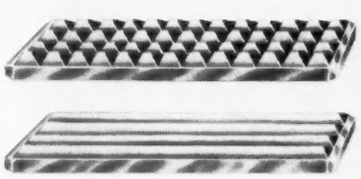


The horizontal oil and gas separator of a new portable well testing unit is 24 inches o.d. by 6 feet seam to seam, and is rated at 600 pounds per square inch working pressure. Welded gas run is equipped with facilities for metering gas and has diaphragm type gas back pressure valve for maintaining constant pressure on the unit. Oil and gas outlet tie-in line is furnished to permit rejoining the oil and gas after metering, if desired. The No. 6H-2406 Wellchecker has facilities for addition of automatic free water knockout which removes and meters free water produced. The unit is also available skid-mounted.

For additional information, write Rolo Manufacturing Company, 2510 South Boulevard, Houston.

### *Tong Dies*

**This item supplements Drilling Equipment Manufacturing Company data on pages 1442-1447 of Composite Catalog, 18th Edition.**



"No Chip" tong dies are made of high quality steel and are available in standard lengths for both 1- and 1¼-inch die slots. The chip-proof ends eliminate danger of bits of metal flying from the die while it is being driven into the slot. They are reversible for longer wear.

For additional information, write Drilling Equipment Manufacturing Company, 845 S. E. 29th Street, Oklahoma City.


MAKE THE RIGHT MOVE

INSIST ON ALTEN SURFACE EQUIPMENT

LUBRICATED STUFFING BOX

STUBBY TUBING HEAD

CLOVERLEAF STUFFING BOX

Alten equipment gives you deluxe features at rock bottom prices.

STOP COCK

WONBOLT POLISHED ROD CLAMP

It costs Alten far more to build equipment so that it costs you far less to operate and maintain it.

THE WORLD'S BEST PUMPING UNIT

Longest Strokes
Highest Gear Reducer Ratings
plus
Hardest Gear Surfaces

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Pumping Units, Tubing Heads, Stuffing Boxes — every piece of equipment in the broad Alten line is fully performance proved. Get more for your money from the smallest Polished Rod Clamp to the largest Pumping Unit by asking your dealer to furnish Alten equipment.

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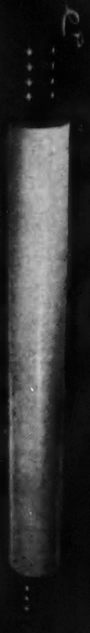
**PARELEX**

**Electric Heaters**

for

**Oil Wells**

Bottom Hole Tubing and Flowline Heaters for Paraffin and Heavy Crude



Model BH3

Write for Details

**PARELEX CORPORATION**

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PARMACO — PARKERSBURG MACHINE CO. — PARKERSBURG, W. VA. U.S.A.

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*And on our 50th Anniversary we again invite you to Standardize on*

**PARMACO PRODUCTS**

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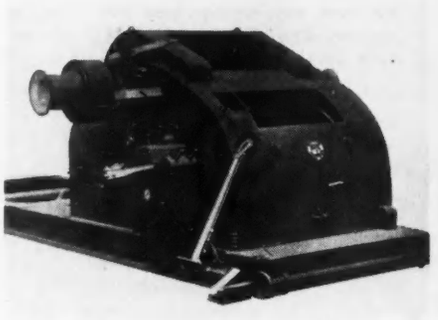
PARKERSBURG, W. VA.


# NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

## Shallow Drilling Rig

**This item supplements The National Supply Company data on pages 3433-3564 of Composite Catalog, 17th Edition.**



A new Ideal Type T-32 Consolidated drilling rig, designed to supplant the older T-25 Rig, by employing a larger torque converter, permits the use of greater horsepower and is normally considered for drilling in the 3000 to 5500 feet depth range.

The redesigned rig includes a Model 11,500 series Twin Disc torque converter and changes in ratios in the drawworks transmission. With increased available power the T-32 has ample reserve hoisting capacity for use in emergencies such as pulling on stuck pipe.

Retained from the original rig are the air-operated clutches on the main drum and rotary drives, and the Fawick Airflex inertia brake. The brake is used to stop rotating parts when making speed changes. A plain drum of the free spooling type has a barrel length of 39 inches and diameter of $15\frac{13}{16}$ inches.

A three-speed transmission permits operation of the torque converter in its most efficient range at all times. Single engines such as the Superior Model 6G-510 or PTD-6 or dual engines with a combined capacity of 320 horsepower may be used to power the T-32. The rig and engine are skid mounted as a unit, making for easy portability.

For additional information, write The National Supply Company, Box 899A, Toledo, Ohio.


**SYCO "Hard Hole" CHOKES--**

**Save Money--Last Longer!**

"Hard Hole" CHOKES, Types A, B and C, were specifically designed for long life. Manufactured of heat treated tool steel, they are corrosion and abrasion resistant. The cost of HARD HOLE CHOKES is in keeping with conventional chokes.

**Features:**

"Hard Hole" Chokes pay for themselves in service and wear.

They simplify warehousing and handling as the Type "A" Choke with a simple adapter will fit practically all types of popular Christmas Trees.

Type "B" was developed to fit flow wings to which Type "A" is not adaptable.

Proved in use by major operators for the last four years.

A complete size range is available. We specialize in the solution of choke problems.

Write, wire or phone for literature or additional information.

Type "A" Choke and No. 1 Adapter.

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# Republic National Bank of Dallas

*Statement of Condition, April 9, 1951*

## *RESOURCES*

| | |
|---|---|
| Cash and Due from Banks | $113,569,361.35 |
| U. S. Government Securities | 37,578,741.39 |
| State, Municipal and Other Securities | 4,388,586.47 |
| Stock in Federal Reserve Bank | 975,000.00 |
| Loans and Discounts | 201,720,612.75 |
| Bills of Exchange and Commodity Loans | 20,711,380.67 |
| Bank Premises and Equipment | 2,354,235.69 |
| Real Estate for Bank Expansion | 2,528,131.37 |
| Acceptances—Customers Account | 6,977,572.10 |
| TOTAL | $390,803,621.79 |

## *LIABILITIES*

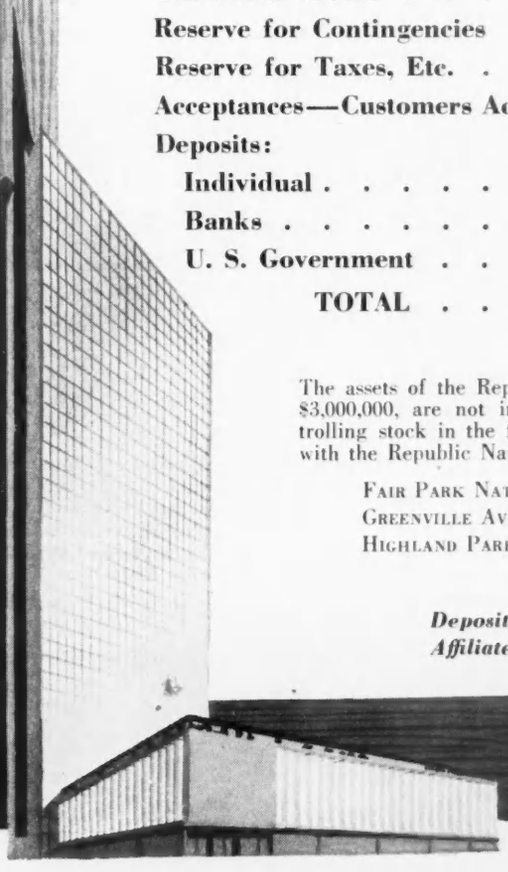
| | | |
|---|---|---|
| Capital | $ 16,000,000.00 | |
| Surplus | 16,500,000.00 | |
| Undivided Profits | 3,964,899.38 | 36,464,899.38 |
| Reserve for Contingencies | | 2,503,221.71 |
| Reserve for Taxes, Etc. | | 2,067,942.99 |
| Acceptances—Customers Account | | 7,078,572.10 |
| Deposits: | | |
| Individual | 234,468,061.12 | |
| Banks | 92,178,062.27 | |
| U. S. Government | 16,042,862.22 | 342,688,985.61 |
| TOTAL | | $390,803,621.79 |

* * *

The assets of the Republic National Company, including its capital stock of $3,000,000, are not included in above statement. The Company owns controlling stock in the following banks located in Greater Dallas, all affiliated with the Republic National Bank:

FAIR PARK NATIONAL BANK — LAKEWOOD STATE BANK
GREENVILLE AVENUE STATE BANK — NATIONAL CITY BANK
HIGHLAND PARK STATE BANK — OAK CLIFF BANK & TRUST CO.
OAK LAWN NATIONAL BANK

***Deposits of the Republic National Bank and Affiliated Banks aggregate $436,427,290.39***



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

# OTHER NEW AND IMPROVED EQUIPMENT

## Rig and Engine Cleaner

A setup for cleaning exteriors of oil field pumping engines and rig floors has been devised for use with an emulsion solvent cleaner, Magnusol. Two 40-gallon tanks mounted on the bed of a pickup truck are equipped with filling cocks at the top and drain cocks at the bottom. A small gasoline driven centrifugal pump is connected so that it pumps from either tank. It delivers about 40 pounds per square inch to 25 feet of rubber hose fitted with an adjustable nozzle. Magnusol, mixed one part to eight parts kerosine, is charged in one of the tanks, while the other is filled with water. The engine and floor are sprayed with the cleaning solution, which is allowed to soak in about an hour. The pump is then switched over to the water tank and engine and floors rinsed clean.

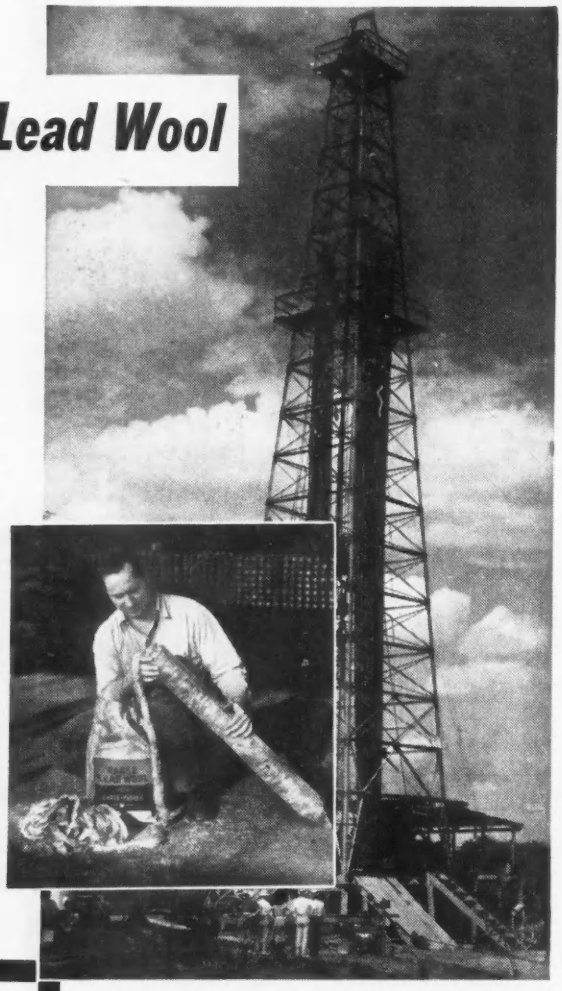
For additional information write Magnus Chemical Company, Inc., South Avenue, Garwood, N. J.


**Eagle-Picher Lead Wool**

**STOPS**

***bottom water***

Rule out the risk of oil-wasting bottom water shutdown by tamping Eagle-Picher Lead Wool in the hole. The finely stranded, flexible metallic wool makes a water-tight plug that seals every crack and crevice. Comes in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.



**THE EAGLE-PICHER SALES COMPANY**

Since 1843

**Metallic Products Division, General Office, Box 777 East Chicago, Indiana**

Cincinnati • Kansas City
East St. Louis • Dallas • Houston

Member: Lead Industries Association

2065-LW

EAGLE EP PICHER

***These 3 Eagle-Picher Bearing Metals meet most requirements***

1. **Dreadnaught** — for extreme speed and heavy-duty conditions.
2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.


## pH Meter

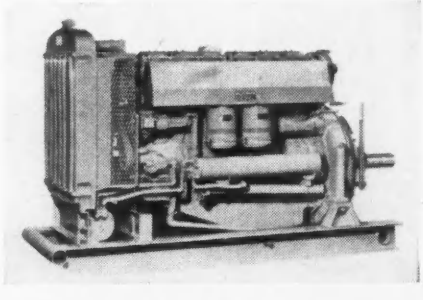
A pocket-size pH meter and companion probe unit permit instant pH determinations anywhere. Self-contained with batteries, in a bakelite case 3 x 5⅞ x 2½ inches, the instrument is furnished with case and plastic tubes of buffer and KCl solutions. Total weight is three pounds. Supports and beakers are eliminated by combining the calomel and glass electrodes with the sample holder in a single polyethylene probe unit. A sample volume of only 0.5 ml. is required. The meter is scaled from 2 to 12 pH, and an adjustment gives readings from 0 to 14. Accuracy of 0.1 is obtainable, the manufacturer claims. Electrometer tube, switch and input connector are sealed in one unit. Grounded samples can be directly measured because of no external power connections.

For additional information write Analytical Measurements, 585 Main Street, Chatham, N. J.

## Heavy Duty Diesels

A new line of heavy duty diesel engines, consisting of six models from 145 hp to 220 hp, is designed to operate at continuous speeds up to 1400 rpm. This higher operating speed will make possible the application of Murphy Diesels in new services including those requiring torque converter power transmission. Murphy characteristics such as "true" diesel operation, unit fuel injection, four valves per cylinder, hydraulic servo-type governor, etc., remain as the basis of the new line.

For additional information write Murphy Diesel Company, 5313 West Burnham Street, Milwaukee 14.



# The New Cable-Tool Era

Oil men are among the quickest in the world to recognize, and accept, worthwhile change. During the five years since Walker-Neer Spudders first entered the field, the demand for them has skyrocketed. Today, it is the popular conviction, throughout the industry, that Walker-Neer Spudders are the finest ever built. 25 years' prior experience in the manufacture of cable-tool equipment is behind them.

Walker-Neer developments have practically eliminated spooling problems . . . enabled longer runs . . . freed the drilling motion from all solid jar . . . improved efficiency of controls . . . increased versatility . . . insured power and efficiency under adverse conditions . . . prolonged line life . . . and reduced maintenance expense to a new low.

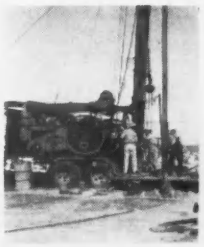
You don't have to travel far, generally, to observe a Walker-Neer Spudder in action; a few are pictured here. The location of one operating near you will be gladly furnished upon request. Write, also, for descriptive literature.

C. M. Carter's S-32 Special, drilling top-to-bottom to 2800', Wallaceburg, Ontario.

## WALKER-NEER
## *Has Set a New Standard*
## of Spudder Performance

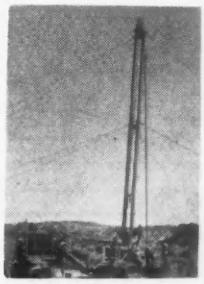
One of J. W. McKee's TWO Walker-Neer Spudders, an S-33, drilling top-to-bottom in Loco Hills, N. M.

Mor-Lee Drilling Co.'s S-32 Special, drilling top-to-bottom at 2800', Tulsa, Okla.



One of Abernethy Drilling Co.'s TWO Walker-Neer Spudders, a C-34, completing its 8th well to 4000', Crane, Tex.

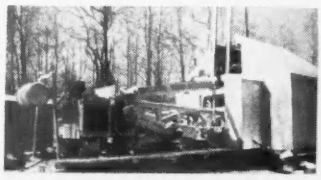
Emerson & Waring's S-32, drilling top-to-bottom at 1800', Dunville, Ontario.



One of Buck Jones Drilling Co.'s THREE Walker-Neer Spudders operating in West Texas.

Layne-Hispano's TWO S-32 Specials in transit to Mex. City, for drilling 24" hole to 900'.

Two of Felipe de J. Avila's FIVE Walker-Neer WS-31's shipped to Monterrey, Mex.

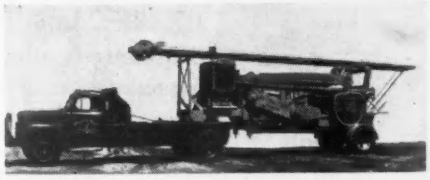


Tidewater Associates' S-32 Special, pulling pipe and servicing old wells, Bradford, Penn.

One of Art Roach's FIVE Walker-Neer Spudders, an S-32, all working in Central Texas.

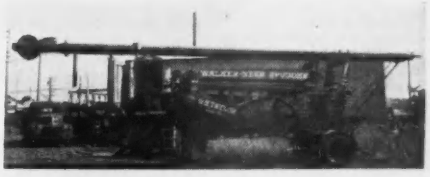
One of Carter Drilling Co.'s TWO C-33's, in transit to Great Bend, Kan., servicing at 4000'.

One of Gulf Oil Corp.'s TWO C-34's, wildcat test to 5800', Monahans, Tex.



One of Henry F. Parker's FOUR Walker-Neer Spudders, an S-32 Special, drilling top-to-bottom, McCamey, Tex.

Scott, Bell & Gault's S-32, in transit to Reed City, Mich., for drilling top-to-bottom to 4000'.



One of G. S. Taylor's THREE Walker-Neer Spudders, an S-32 Special, shipped to Snyder, Tex.

# STITT

**the *Standard Gas* Engine**

## *Spark Plug*

**SINCE 1918**

- ★ Improved Insulation
- ★ Long Electrode Life
- ★ One-Piece Construction
- ★ Non-Fouling
- ★ Pressure Seal

***At Your Supply Store!***

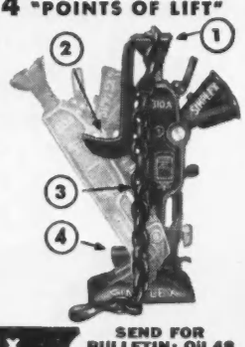
**4-WAY LIFTING POWER with this SIMPLEX 310-A EMERGENCY JACK**

Powerful 310-A Simplex EMERGENCY JACK is easy operating, will lift vertically or push or lift in any position.

"Get the Simplex" is the call on drilling jobs when men want quick, safe jack action. The double lever socket enables them to work in close quarters and at any angle.

This 15-ton Ratchet Lowering jack will lift or lower from four points—on the rotary cap, on the auxiliary cap shoe, on the serrated toe lift, or from any intermediate height by using the chain as a sling.

**4 "POINTS OF LIFT"**




Simplex LEVER · SCREW · HYDRAULIC Jacks

SEND FOR BULLETIN: Oil 48

TEMPLETON, KENLY & CO.

1032 So. Central Ave., Chicago 44, Illinois


## OTHER NEW EQUIPMENT

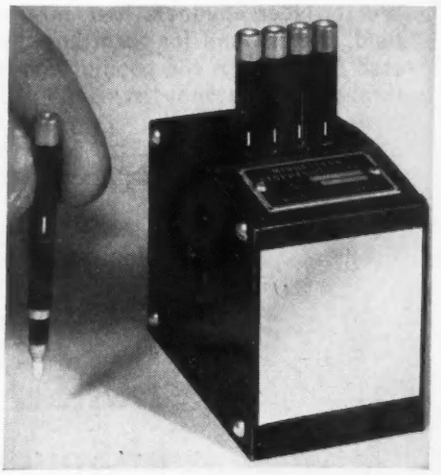
### *Stripper Well Pumping Unit*

The Salentine Varicycle pumping unit is a long-stroke, hydraulic unit for stripper wells. Instead of pumping fluid from the formation in high speed jerks, it allows the fluid to come in from the formation at its own optimum rate under conditions which approach a constant flow. This method is derived from a simple arrangement which allows downstroke speed to be varied independently of the upstroke speed. As an example, the optimum plunger speed might be such that the upstroke should be made in 30 seconds. This is set by the power pump speed and displacement. The downstroke, in this case, could be set as low as 2½ seconds by an adjustment at the cylinder. This results in a low speed at constant velocity during 90 percent of the cycle, then a quick drop of the plunger, cushioned at the end by a dashpot. Thus the machine is operating within 10 percent of constant flow. No foundation is necessary, as an A-frame is sufficient to set the unit up.

For additional information, write S. C. Carter Company, Inc., 1900 Santa Fe Avenue, Los Angeles.

### *Galvanometer*

A new galvanometer is so sensitive that it can be used in most applications directly from source without amplification, and it has a normal balance of only .003 inch per Gauss at 12 inches focal distance. Known as Model 106-SS, this new galvanometer within comparable frequencies, is 50 to 100 percent more efficient than the most sensitive galvanometer formerly available, the manufacturer claims. It has individual circuits for both terminals of



the element. Normal balance is said to be four times better than other galvanometers and for special applications with severe vibration conditions it can be balanced to less than .001 inch deflection G. Due to new method of suspension the bow string effect is practically elimniated.

For further information write Midwestern Geophysical Laboratory, 2803 West 40th Street. Tulsa.


# CATAWISSA PERFECT SEAL UNIONS

**deliver sure-fire piping dependability THROUGHOUT THE OIL FIELDS!**

In high or low pressure, extremely high temperature or corrosive piping conditions, CATAWISSA HOT FORGED STEEL UNIONS are maintaining their long-standing reputation for sure-fire piping dependability!

**CATAWISSA PERFECT SEAL UNIONS are designed and produced for dependable, long-life service under the severest piping conditions—made with hand ground seats that require no packing and feature Catawissa's Ball-To-Angle seat design which gives a PERFECT SEAL even when the pipe is not in alignment!**

write or call for your copy of the NEW CATALOG 11 showing the complete CatawissaLine

*stocked and distributed by*

**OIL WELL SUPPLY CO.**

Branches Serving All Oil Fields

Catawissa Valve & Fittings Co.—Catawissa, Penna.

TANKER OR BARGE

DOCK

# CHIKSAN MARINE & BARGE HOSE

***LIGHT WEIGHT • EASY TO HANDLE***

With the **CHIKSAN** aluminum Marine & Barge Hose, dock-to-vessel connections can be made by one man in just a few minutes. When not in service, the hose easily and quickly folds into a compact unit, without requiring disconnection from the Dock Riser. The same hose can be used for both suction and discharge.

## MANY EXCLUSIVE ADVANTAGES

The **CHIKSAN** Hose, when used as shown, saves time, labor and expense, as well as dock space, and permits free movement of other equipment.

**CHIKSAN** Marine & Barge Hose, being made of metal, is not affected by severe climatic conditions or by petroleum products which may cause other hose to deteriorate rapidly. For the same reason, this all-metal hose is not subject to kinking, crushing or cutting—thus outlasting other hose.

**CHIKSAN** Marine & Barge Hose can be supplied in any required length and size, with end connections as specified, in either aluminum or steel, for above-surface or underwater service.

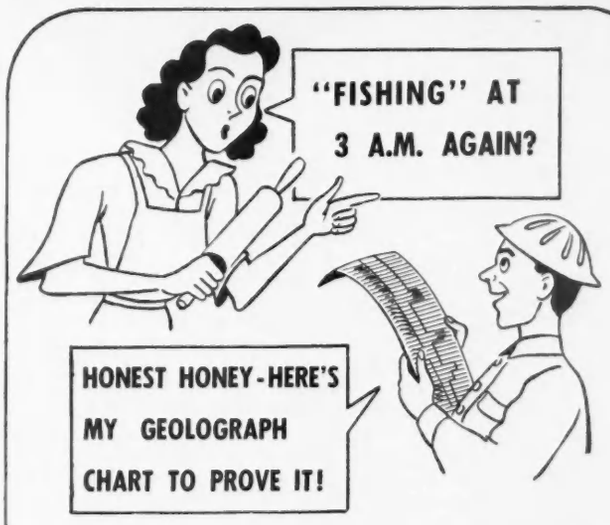
CHIKSAN TRADE MARK REG.

**CHIKSAN COMPANY**
AND SUBSIDIARY COMPANIES
Chicago 3, Ill. **BREA, CALIFORNIA** Newark 2, N. J.
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.

**BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES**

**WRITE FOR COMPLETE CHIKSAN CATALOG**

***REPRESENTATIVES IN PRINCIPAL CITIES***
***SOLD BY LEADING SUPPLY STORES EVERYWHERE***

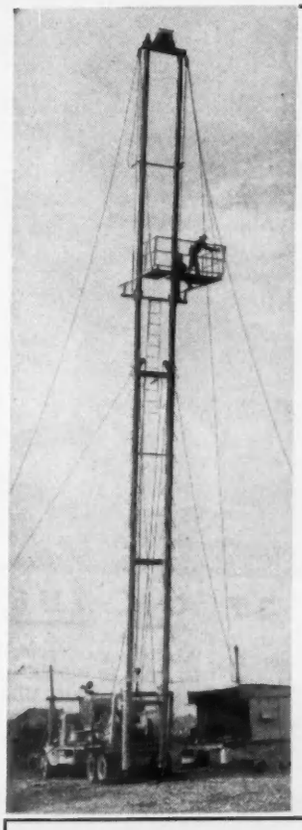



You get the important details as *you drill*, when you use Geolograph Mechanical Well Logging Service! It's the *sure* way to keep up to the minute . . . to know where you are *all the time!* Complete enough for any job — yet reasonable enough for the small operator.

ABILENE, HOUSTON, ODESSA & WICHITA FALLS, TEX. • CASPER, WYO.
SHREVEPORT & BATON ROUGE, LA. • BAKERSFIELD, CALIF.

GEOLOGRAPH TIME WILL TELL

*"TIME WILL TELL"*
**THE GEOLOGRAPH CO. INC.**
P. O. Box 1291 Oklahoma City 1, Okla.



# S & R

*Custom Built*

## PORTABLE TELESCOPING POLE MASTS

This S & R double ladder mast is of heavy welded steel construction, and is fabricated of 10¾" pipe and 8⅝" pipe. Overall dimensions when erected 87 feet to crown support beam and 52' 0" when telescoped in traveling position.

Approximate weight of the complete equipment is 12,000 lbs.

The complete assembly includes the (1) poles, (2) breakdown shaft assembly, (3) attached racking platform (which positions itself when poles are raised), (4) pole adjusting screws, (5) a sheave assembly to be mounted on truck or trailer for raising the poles, (6) and a four or five 24 inch sheave crown block for ⅞" line.

Available for truck, trailer, or skid mount.

**For additional information write, wire, or phone**

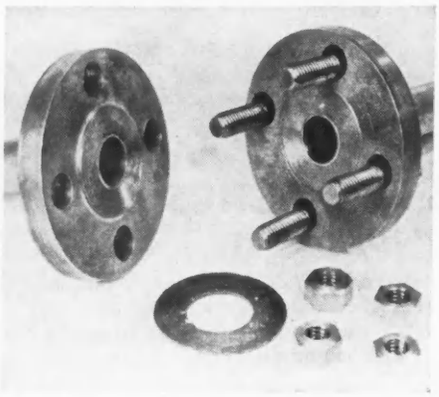
**S & R TOOL & SUPPLY CO.**
P. O. Box 1755 155 McCarty
HOUSTON 1, TEXAS
Export: 233 Broadway, New York 7, N. Y.

S&R TOOL — SUPPLY CO. HOUSTON, TEXAS

## Fittings

In addition to standard tubing sizes, a new line of corrosion-resistant fittings are made for use with corrosion-resistant pipe in Schedules 5S, 10S and 40S.

The Speedline tube and pipe union, shown, is lightweight and is bimetallic. The hex nut is made of carbon steel or monel, while parts coming in contact with corrodents are made of other metals suited to the application. The union permits the use of light-wall piping systems to handle pressures for which the tubing or pipe is designed. In both tube sizes and nominal pipe sizes, the union is made for ½ through 4-inch applications.



The Speedline insert flange consisting of a corrosion-resistant, serrated insert in a carbon steel flange, is available in sizes for standard tubing O.D.'s and gauges, and nominal pipe sizes from ½ through 6 inches. The aligning connector can be used with either Schedule 40S or 5S pipe, and is joined by means of soft soldering, silver brazing or socket welding.

For additional information, write Horace T. Potts Company, Erie Avenue and D Street, Philadelphia 34.

## Solid Front Gauge

A new solid front gauge has a solid cast web backing up the dial, with the entire back of the case covered by a waterproof blow-out disc with bonded Buna N seal. In the event of bourdon tube rupture due to overpressure, corrosion, or any other factor, the blow-out disc relieves the pressure in the case, acting positively at case pressures between ½ and 3 pounds, depending on size of case and type of connection. The solid front restrains such pressures with the case. Removal of the waterproof disc exposes the mechanism for inspection, repair, or recalibration without removing the dial.

For additional information, write Acragage Company, Wampus Lane, Milford, Conn.

## Oil Field Tractor

A compact, fast, highly mobile carrier for oil field well servicing equipment can roll at speeds of from 30 to 40 miles per hour. The unit combines Walter Four Point positive drive system, large single tires with low pressure requirements, 90-inch wheelbase, and high ground clearance of 16 inches. Weight is equally distributed between front and rear tires. The 125 hp six-cylinder motor has 404 cubic inch piston displacement, and the tractor type transmission has six forward and two reverse speeds.

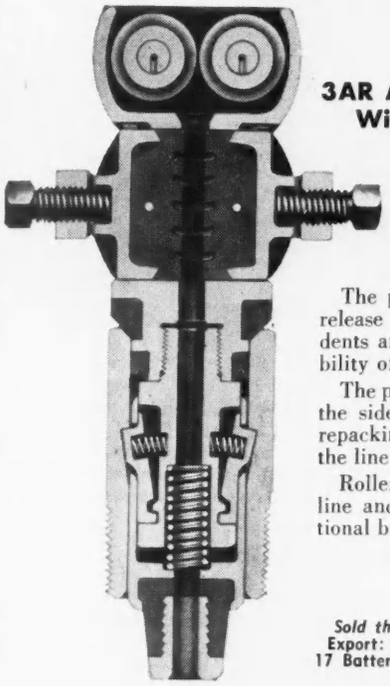
The unit develops a tractive effort of more than 12,000 pounds at three miles per hour.

Total weight is approximately 16,000 pounds.

For additional information, write Walter Motor Truck Company, 1001 Irving Avenue, Ridgewood 27, N. Y.

THE LITTLE PUMP WITH A THOUSAND USES!
MODEL 37 ON THE JOB!
"The handiest pump we've got is how they describe this little giant of dependability, pictured above—CMC Model 37 on the job for Olson Drilling Company of TXL Field, Eaton County, Texas.
Whether your pumping needs call for 3,000 or 200,000 gallons per hour, there is a CMC DUAL-Prime pump that will handle the job right! Our engineers are at your service! Write us for details.
CONSTRUCTION MACHINERY CO'S.
WATERLOO, IOWA, U.S.A.
3340 Dixie Drive, Houston 21, Texas • Phone: LInden 3988

# FOR SWABBING— *Be Sure* IT'S A KING *Be Safe* —FOR CORING



### 3AR Automatic Release Wire Line Stripper

Type 3AR King Wire Line Stripper is the ideal tool for use in swabbing operations.

The positive latch and sure release insure against accidents and eliminate the possibility of breaking a line.

The packing is inserted from the sides of the stripper and repacking is easily done while the line is in the hole.

Roller line guides center the line and outwear the conventional bushing.

*Sold through your supply store*
Export: R. S. Stokvis & Sons, Inc.
17 Battery Place, New York, N. Y.

### 4AR King Type Stripper For Wire Line Coring

Type 4AR Wire Line Stripper is similar to the 3AR, except it is a little larger. Although it can be used for swabbing, its primary use is for wire line coring operations. The 4AR is commonly used with King circulating heads. When required, both the 3AR and 4AR can be furnished with 1½" pipe thread on the bottom for attachment to a trip bar.

See your latest Composite Catalogue for detailed descriptions of other King Tools.

# KING OIL TOOLS

**210 Terminal Street** **Phone OS 3-3421**

**HOUSTON 20, TEXAS**



# *"Mud-O-Graf"*

## CONSTANT MUD CONTROL BLOWOUT PROTECTION

**The Mud-O-Graf eliminates the usual trial and error method of adding weighting material or water to maintain the correct specific gravity.**

**The condition of mud in the hole is recorded automatcially during every minute of drilling operations. With this information constantly before the driller, he can maintain a uniform mud weight. He can instantly detect weight variations of less than 1/10-pound per gallon, the presence of gassy streaks, their volume and frequency of occurrence. Possibility of blowouts, caused by gas or salt water incursions ordinarily not detected until strong enough to cause the well to kick, is minimized.**

**Write today for further information showing how the Mud-O-Graf will benefit you.**

## *Check these advantages:*

- **Provides accurate information for uniform mud control.**
- **Helps prevent blowouts by showing the duration and relative amount of gas in gassy streaks.**
- **Increases accuracy in the use of weighting materials, chemicals, and water.**
- **Indicates graphically all heavy and light streaks in the circulating system.**

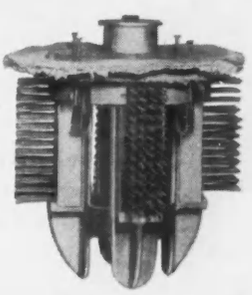
WARREN AUTOMATIC TOOL CO. HOUSTON — WATCO

**WARREN**
AUTOMATIC TOOL CO.
1920 HUSSION ST. - HOUSTON, TEXAS
LAFAYETTE, LA ODESSA, TEXAS

# THE CAVINS DUMP BOTTOM...

is the tool you need for dumping any amount of cement, sand, gravel, acid, or chemical, etc., in a continuous operation without interruption. The full open throat eliminates the hazard of stringing a load through the fluid column. There are no valves, sleeves, or ports to become fouled or clogged—no danger of accidental or premature unloading due to line whip or faulty brakes.

### THE CAVINS BRIDGING PLUG



... for use in combination with the CEMENT DUMP BOTTOM, is ideal for use in starting an off-bottom bridge or plug. Made of drillable material, the Cavins Bridging Plug can be used for temporary or permanent installations.

*24 HOUR SERVICE FROM . . .*

## THE CAVINS COMPANY

Long Beach: 2853 Cherry Ave., Phone 485-64 • Ventura: 1641 N. Ventura Ave., Phone 6767 • Santa Maria: Phone 1210-L • Bakersfield 1120 33rd St., Phone 6-6860 • Taft: 204 Center St., Phone 1127

37th YEAR
SERVING THE OIL FIELD AND ASSOCIATED INDUSTRIES

IF WE DON'T HAVE IT — WE WILL MAKE IT

FIRST-CLASS MACHINE SHOP
■ MODERN MECHANIZED GRAY IRON FOUNDRY

WE SPECIALIZE IN . . .
★ REBUILDING AND TESTING ENGINES • COMPRESSORS AND PUMPS
★ NEW AND REBUILT OIL AND GAS FIELD SUPPLIES AND EQUIPMENT
★ REPAIR AND REPLACEMENT OF ALL INDUSTRIAL EQUIPMENT

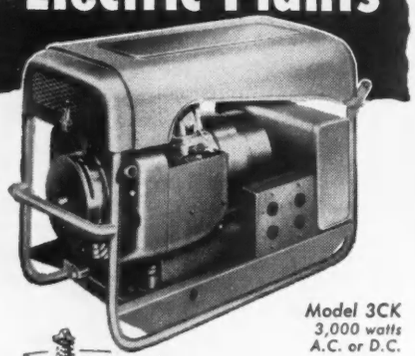
SUPPLIES · EQUIPMENT · REPAIRS

WE *can* FILL YOUR NEEDS

WRITE OR WIRE US, TODAY
PHONES 874 - 875

ACME FOUNDRY & MACHINE CO.
COFFEYVILLE • KANSAS

ONAN *Oilfield* Electric Plants



Model 3CK
3,000 watts
A.C. or D.C.

HEAVY-DUTY PORTABLE & STATIONARY MODELS
*Diesel, Gas, Gasoline-powered*

● ONAN oilfield electric plants provide dependable light and power for oil field applications. A complete range of A.C. and D.C. models . . . all conservatively rated for continuous, dependable service helps you choose the right plant for the job. Lightweight, air-cooled models from 400 to 5,000 watts; heavy-duty, water-cooled, gas-gasoline-driven plants from 3,000 to 75,000 watts. Air-cooled Diesel electric plants 2,500 and 5,000 watts. Water-cooled Diesels from 12,500 to 75,000 watts, powered by IH engines.

*Write for Literature*

D. W. ONAN & SONS INC.
5964 Royalston Ave., Minneapolis 5, Minn.

## OTHER NEW EQUIPMENT

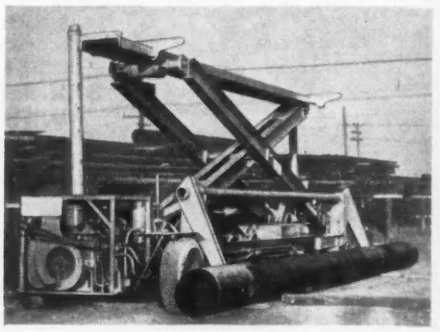
### Mobile Radio

A rugged two-way mobile radio unit designed for adjacent channel operation combines a 10-12 watt FM transmitter receiver and power supply in a single wrap-around housing. The MRT-5B communications unit has a shockmount which operates on either of two radio channels in the 152-162 megacycle band. Its design permits installation on machines and vehicles where heavy shocks and vibrations are encountered. It may also be used at base stations.

For additional information, write Mr. Barnhill, Bendix Radio division of Bendix Aviation Corporation, Baltimore 4, Md.

### Pipe Loader

Hydraulically operated by remote control, the Pridy Straight Lift Pipe Loader picks up one or several joints of pipe, places the load on a truck or gondola, and returns to position for another lift. The number of joints per load varies according to the size of the pipe. The machine will lift a maximum load of 4000 pounds to any height up to 11 feet 6 inches. Control is accomplished by means of control cords attached to a four-way valve on the loader. Hydraulic power is derived from a fluid pump driven by an air-cooled engine at the rear of the unit. The loader is self-propelled, but is also designed to be towed. The same fluid under pressure which drives the lifting mechanism is used to propel the unit at a top speed of four miles per hour by directing the fluid into a fluid motor



which is directly connected with the transmission. A chain drive between transmission and differential completes the drive with four speeds forward and reverse.

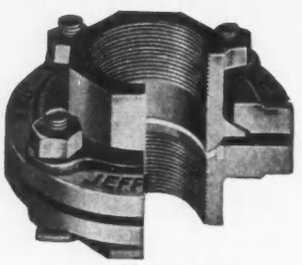
For additional information, write The Republic Supply Company of California, 2600 Eastland Avenue, Los Angeles 22.

### Sealing Compound

A new compound, Bestolife Lead Seal No. 960, effects a tight seal on lines carrying liquid petroleum. Used as a joint compound in sealing, fitting and mating of engaged threads, it relieves friction, seizure and galling of mated surfaces, facilitates assembly of parts and prevents freezing of joints. It may be used in making press fits or metal-to-metal fits, and on threads of bolts, nuts, studs, etc.

For additional information, write I. H. Grancell, 1601 Nadeau Street, Los Angeles 1.

Jefferson Malleable Unions



STYLE "B"

JEFFERSON Style "B" three-piece flange union is made with brass-to-iron and iron-to-iron seats. Being made of highly refined AIR FURNACE iron. it assures you of lightweight construction, perfect ball joint, and positive seating arrangement, whether or not in alignment.

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| Sizes | Test Pres. | O. W. G. | S. W. P.-550 Deg. |
|---|---|---|---|
| ½" thru 4" | 2000# | 800# | 250# |
| 5" and 6" | 1200# | 500# | 250# |
| 8" and 10" | 1000# | 400# | 250# |

Malleable iron used in all JEFFERSON unions meets ASTM 4733, Grade 35018—M. T. 53000 Lbs., giving 75% more elongation 50%-more impact value and is 30%-stronger than cupola malleable iron.

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MULEHEAD. QUICKLY DETACHABLE. SLING LOAD EQUALISED.
SADDLE. NEEDLE BEARINGS, LATERAL AND LONGITUDINAL ADJUSTMENT TO ALIGN MULE-HEAD WITH POLISHED ROD.
EQUALISER. NEEDLE BEARINGS IN ADJUSTABLE SPHERICAL MOUNTING. QUICK RELEASE FROM WALKING BEAM AND EQUALISER BEAM.
CRANKPIN. LE GRAND PATENT. QUICK RELEASE FROM CRANK. HEAVY DUTY SELF-ALIGNING ROLLER BEARINGS. RUGGED CONSTRUCTION.
LEVER OPERATED BRAKE
PROVISION FOR EXTENDED BASE FOR PRIME MOVER. INCORPORATES REAR OPERATED BRAKE LEVER.
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# Pumping Units

RUGGED CONSTRUCTION AND PRECISION BUILT THROUGHOUT.

**Unit illustrated is the 25/72.C.C. Model with double helical double reduction gear box. 330,000 lbs. ins. Peak Torque. Polished Rod Load 25,000 lbs. Polished Rod Strokes. 24″ 36″ 48″ 60″ 72″.**

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OILFIELD EQUIPMENT MANUFACTURERS & FOUNDERS

## Couplings

Steelflex piloted type couplings, designed to support a long shaft extension or floating shaft, are described in a new two-color folder. The folder is illustrated with diagrammatic sketches and photographs, and contains a selection table.

For a copy of this folder, write The Falk Corporation, 3001 West Canal, Milwaukee 8.

## Jacks

A new 16-page bulletin, Catalog 1515, illustrates the Buda line of ratchet, screw and hydraulic jacks in capacities from 3 to 75 tons. The bulletin includes a table for jack selection, application pictures, recommended uses for jacks, and specifications.

For a copy of this catalog, write The Buda Company, Harvey, Ill.

## Speed Reducers

Two bulletins illustrate the new Falk Concentric Shaft speed reducer and Right Angle Shaft all-steel speed reducer. The speed reducers are adaptable to electric motor drives, belt drives, gas engine drives, chain drives, etc.

For copies of these bulletins, write The Falk Corporation, Milwaukee 8, Wis.

## Lightweight Additive

Strata-Seal, a lightweight additive to combat and prevent lost circulation of drilling mud, is described in a new two-color, four-page folder.

For a copy of this folder, write Strata-Crete Sales, Great Lakes Carbon Corporation, 5845 Atlantic Avenue, Long Beach 5, Calif.

## Powered Equipment

A complete listing with pictures and brief specifications of all but two of the current line of 81 "Caterpillar" products is contained in a new 40-page booklet. Nine of the eleven new models announced last year are listed.

For a copy of form 30081, write Caterpillar Tractor Company, Peoria 8, Ill.

## Hydraulic Pullers

Applications of hydraulic pullers and jacks are discussed in a new eight-page bulletin, Hydraulic 51. The bulletin also introduces Simplex Re-Mo-Trol hydraulic pumps and remote-controlled rams. Complete specifications of Re-Mo-Trol units and all other Simplex hydraulic jacks and jennies are included.

For a copy of this bulletin, write Templeton, Kenly and Company, 1020 South Central Avenue, Chicago 44.

## Slush Pumps

The new Ideal Type E-500 power slush pump with 7¾-inch maximum fluid cylinder liner bore and 14-inch stroke, and a maximum recommended working pressure of 3500 psi, is covered in a new Bulletin No. I-371. The bulletin has eight pages describing features of design and lubrication with illustrations of the pump, certain parts, and dimensional line drawings, and includes specifications and performance data with six fluid cylinder liners ranging from 7¾ inches to 5¼ inches.

For a copy of the bulletin, write The National Supply Company, Box 899A, Toledo, Ohio.

## Stud Welding

Specifications and performance characteristics of two Nelwelder power units designed to improve and extend the uses of stud welding are described in a new four-page bulletin.

For a copy of this bulletin, write Nelson Stud Welding Division of Morton Gregory Corporation, Lorain, Ohio.

## Compressors

Detailed specifications for Clark high compression Big Angle compressors are included in a new three-color, 40-page catalog. Profusely illustrated with photographs of compressor installations, cutaway diagrams and sketches, the catalog describes Model HBA compressors, which range from 1100 to 220 bhp, and have 5, 6, 8 or 10 cylinders.

For a copy of bulletin 104, write Clark Bros. Company, Inc., Olean, N. Y.

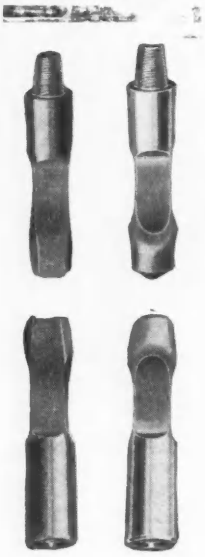

*In the American Tradition*

**PRESERVE YOUR FREEDOM!**

"Freedom is political (and economic) power in small segments."

Concentration of power produces a socialistic control, regardless of the alluring names used by those who bring about such a condition.

Our main concern today is to build our defenses, conserve our resources, eliminate waste and take extra care of our tools to meet the present threat to our country's security. And, as part of this program, we'll have to give up many of our cherished freedoms. But let's make sure these losses are only *temporary*—that those who favor the various artfully named socialistic schemes do not take advantage of the current crisis to permanently set up their planned economy.



**Get** *Maximum*

- **Weldability**
- **Strength**
- **Wear Resistance**

*with*

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**SPANG CABLE TOOLS** made by SPANG & CO. BUTLER, PA.

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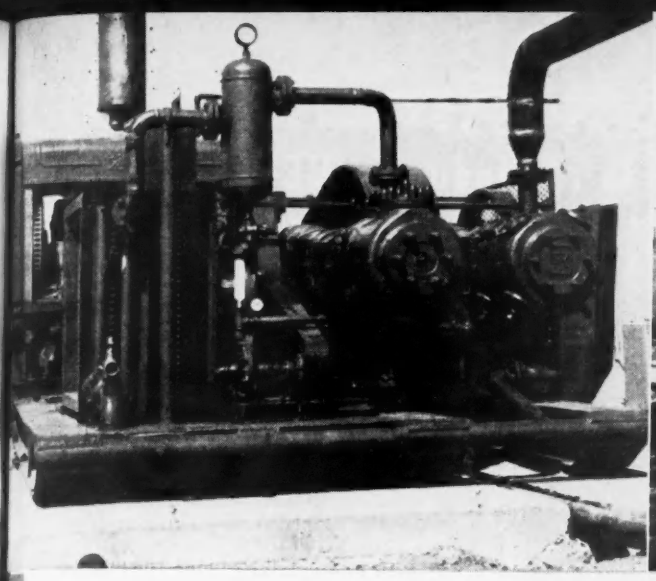

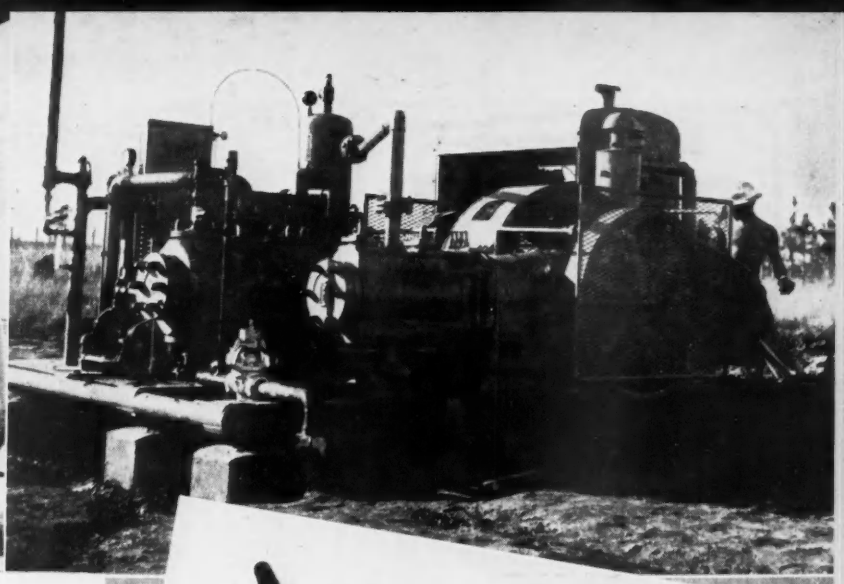

# PROVEN DEPENDABLE *In the Field*

These "Packaged" Portable Machines take the place of far more costly permanent installations and can be furnished in the size to best meet your specific requirements.

What are your needs? Check the sizes and specifications of the eight machines listed below and see if one of these Wilson Supply-Ingersoll-Rand "Packaged" Portable Compressors cannot save you money—

1. 6" x 3¼" x 7"—50 H.P., 20-Lb. Suction, 500-Lb. Discharge, 235,000 Cu. Ft. Per Day.
2. 8" x 4¼" x 9"—75 H.P., 20-Lb. Suction, 600-Lb. Discharge, 402,000 Cu. Ft. Per Day.
3. 8" x 4⅛" x 9"—75 H.P., 20-Lb. Suction, 700-Lb. Discharge, 382,000 Cu. Ft. Per Day.
4. 7" x 4⅛" x 9"—80 H.P., 40-Lb. Suction, 600-Lb. Discharge, 547,000 Cu. Ft. Per Day.
5. 9" x 4¼" x 9"—80 H.P., 10-Llb. Suction, 500-Lb. Discharge, 405,000 Cu. Ft. Per Day.
6. 4⅛" x 9"—45 H.P., 200-Lb. Suction, 600-Lb. Discharge, 630,000 Cu. Ft. Per Day.
7. 3½" x 11"—85 H.P., 800-Lb. Suction, 1750-Lb. Discharge, 1,792,000 Cu. Ft. Per Day.
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*Contact your nearest Wilson Supply Company Store or write "Compressor Division," Wilson Supply Company, P. O. Drawer 19, Houston, Texas, for detailed information, and quotations. Please give suction and discharge pressure and volume to be handled.*

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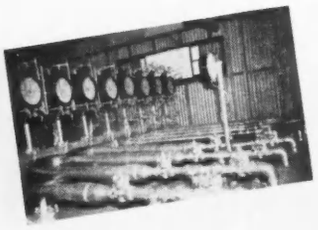

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REPRESSURING WITH GAS OR WATER

SURVEYS
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DESIGN
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PETROLEUM ENGINEERS
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WICHITA FALLS, TEXAS


# Men in the Industry NEWS

**John W. Brice** has been elected to the new post of chairman of the board of directors of The Carter Oil Company, and will take office on completion of his present term as a member of the board of directors of Standard Oil Company (N.J.).

John W. Brice

Brice, a former Carter executive vice president and director, has had a 24-year background of experience in the oil industry with Jersey Standard and it affiliates since he graduated from the University of Texas in 1927. He began work in Texas as a field geologist for Humble Oil & Refining Company and in 1931 went to Venezuela as a geologist for Creole Petroleum Corporation. Eight years later, he was named assistant manager of the Venezuelan company.

Brice first joined Carter in 1942 as a director and vice president in charge of exploration, becoming executive vice president in 1943. In 1945, he was transferred to the Jersey company in New York as assistant coordinator of producing, later becoming coordinator. In 1949, he was elected a member of the Jersey board.

•

**Harvey Cash, Jr.**, assistant to division manager, Oklahoma division, Producing department, The Texas Company, has been advanced to assistant division manager. He was succeeded as assistant to division manager by **J. A. Bermingham, Jr.**, division petroleum engineer. **C. F. Elder**, assistant division petroleum engineer, has been promoted to division petroleum engineer. All three are headquartered in Tulsa.

Cash was graduated from Texas A. & M. College with a B.S. degree in electrical engineering in 1933. Shortly afterward, he joined Texaco in the Geophysical division at Houston, and in 1934 became a computer on a field geophysical party. He was a party chief when he left the company in February, 1942, on military leave. When he returned in 1946, he was made supervisor of field operations, Geophysical division. He was a petroleum engineer with South Texas division until his transfer to the Oklahoma division in 1949.

Bermingham was graduated from the University of Southern California in 1934 with an M.S. degree in petroleum engineering. He joined The Texas Company as assistant petroleum engineer in the Los Angeles Basin. After a series of promotions, he was moved to Tulsa in 1943, and made assistant division petroleum engineer in 1946. He has been division petroleum engineer since 1946.

Elder received a B.S. in petroleum engineering from the University of Oklahoma in 1940. He joined Texaco as a laborer in the Illinois district in 1940, and after a series of advancements, was made district petroleum engineer in the Oklahoma district in 1945. Since 1946 he has been assistant division petroleum engineer.

•

**Alec M. Crowell** has taken a leave from Natural Gas Associated Consultants, New Orleans, to be chief of the Fuel and Chemical Section, New Orleans district, Office of Price Stabilization. After education as a mechanical engineer at the Universities of North Carolina and Kansas, Crowell spent eight years as a petroleum engineer for Cities Service Oil Company and standard Oil Company of New York in the Mid-Continent oil fields. He opened petroleum consulting offices in Shreveport and New Orleans seven years ago.

Alec M. Crowell

Crowell has worked for the Texas Railroad Commission, Arkansas Oil and Gas Commission, Mississippi Oil & Gas Engineering Committee, and the Production and Reserves branch, Oil and Gas division, U. S. Department of the Interior.

•

**Ferrill Rogers**, Oklahoma City, has been named assistant attorney in the Conservation department of the Oklahoma Corporation Commission.


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Repayable on Convenient Terms
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Financing
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## MEN IN THE INDUSTRY NEWS

**Owen F. Thornton** has joined The Louisiana Land and Exploration Company and will be in charge of the Petroleum Engineering department, New Orleans. For the past seven years Thornton has been with The Texas Company as senior petroleum engineer, and has worked with reservoir studies, valuations and other engineering problems throughout the U. S., Canada and South America.

Owen Thornton

Thornton is a graduate of Oklahoma A. & M. College and was employed by Tide Water Associated Oil Company in the East Texas area after graduation until 1944.

•

**Don R. Ford** has been elected to the board of directors of Magnolia Pipe Line Company. Ford, who is assistant manager of pipe lines, joined the Magnolia organization in June, 1927, after his graduation from Marietta College in Ohio. He has worked as pipeliner, district gauger, and chief gauger, and has served in most of the areas in the pipe line system in Texas and Oklahoma. In August, 1949, he was advanced to his present position from division superintendent of the Southern division at Houston, and moved to the company's general offices in Dallas.

**Clarence S. Cone, Jr.**, has been elected an assistant secretary of Magnolia Pipe Line Company. Cone joined Magnolia as a clerk in Dallas in April, 1926. He advanced through supervisory jobs in the company's Accounting department and was appointed chief accountant January 1, 1951.

•

**James C. Melrose**, senior research chemist at Magnolia Petroleum Company's Field Research Laboratories, Dallas, has received one of two graduate fellowships granted by Socony-Vacuum Oil Company, Inc., and its affiliates. Melrose will receive a leave of absence at full salary not to exceed three years to study for a Ph.D. degree at any accredited college chosen by him.

James C. Melrose

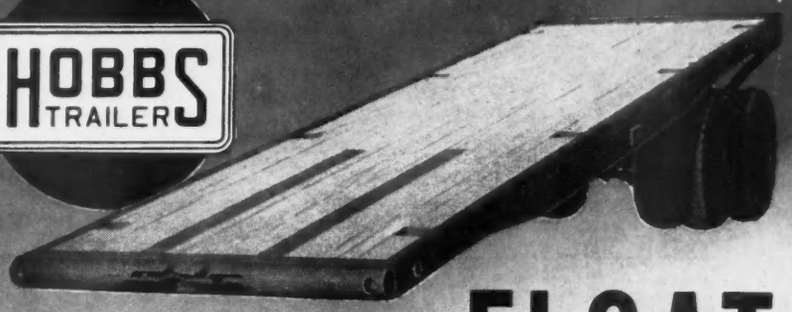
Melrose was graduated from Harvard University in 1943 with a B.S. degree in chemistry. Following graduation, he was employed for three years in the research laboratories of an oil company in Houston. He joined Magnolia's field research laboratories staff at Dallas in August, 1947, and has since been working on improvement of drilling muds.

•

**O. I. Torkelsen** has been appointed to the new post of exploration and production coordinator of the British-American Oil Producing Company, Ltd., with headquarters in Toronto, Canada.


Load 'Em and Move 'Em
With One Man, a Winch and a

HOBBS TRAILER



SELF-LOADING FLOAT
Tandems Rated at 50,000--75,000--100,000 lbs.
Single Axle Model with 30,000 lb. Rating

Load drawn on float by winch line after float has been lowered to ramp position and tractor backed against rear end of float.

After load is in place, tractor is returned to front and float is raised to hauling position by means of winch.

Loaded and ready to go. Entire job done by one man, Hobbs Self-Loading Float, and winch-equipped tractor.

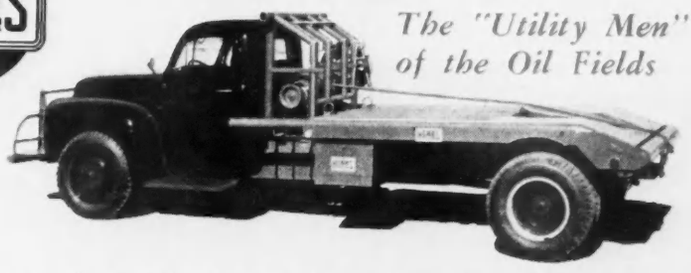
When you have something heavy to move you can always call on your Hobbs Self-Loading Floats. Developed and engineered in the oil fields, this equipment is ideal for moving rigs, draw-works, butane tanks, other heavy and massive units, bulldozers, road building equipment. Hobbs Self-Loading Floats are famous for saving time and labor — for their super strength, easy loading, long service. Write, wire, telephone or cable HOBBS MFG. CO., FORT WORTH, TEXAS, for complete details. (Please mention this publication).

HOBBS MANUFACTURING COMPANY
FACTORY SALES AND SERVICE — Fort Worth, Houston, San Antonio, Lubbock, Texas. DISTRIBUTOR SALES AND SERVICE — Hobbs Trailer Equipment Co., Dallas, Texas; Hobbs Trailer Sales Co., El Paso, Texas; H & H Equipment Co., Okla. City, Okla.; Hobbs Trailer Co., Wichita, Kansas.

HOBBS TRAILER

OIL FIELD and COMBINATION Bodies

*The "Utility Men" of the Oil Fields*



Sturdy all-steel bodies decked with oak or steel plate, equipped with drill-pipe gin poles and extra heavy, rolling tail pipe. Oil Field Body has king pin for engaging inverted fifth wheel mounted on trailing equipment; Combination Body has new cable-released fifth wheel to engage standard king pins.

### *Transfers and Promotions:*

**Barney C. McCasland, Jr.**, appointed district geologist for Cities Service Oil Company at Olney, Ill., transferring there from Jackson, Miss. **Murray G. Wells**, regional geologist for the Oklahoma and North Texas districts, Bartlesville, Okla., promoted to division geologist, Northern Rocky Mountain division, Casper, Wyo. Wells is succeeded by **Paul H. Hyatt** . . . **C. S. Yust**, district petroleum engineer, Pickton district, East Texas division, Humble Oil & Refining Company, transferred to Petroleum Engineering division, Houston, as senior petroleum engineer. **D. T. Colley**, district electrical foreman, Anahuac District, Gulf Coast division, transferred to Snyder district, West Texas division, replacing district electrical foreman **Eddie D. Loggins**, who went to Anahuac . . . **Gus A. Standish** promoted from petroleum engineer in Magnolia Petroleum Company's Lake Charles district to petroleum engineer in the Gulf Coast division offices at Houston. **Clarence Wells, Jr.**, petroleum engineering assistant at Shreveport, transferred to Kermit district. **Dee F. Pendley, Jr.**, petroleum engineer in Electra district, transferred to Kermit district, Midland, Texas . . . **R. E. Dobkins**, formerly foreman for Sun Oil Company in Phillipstown, Ill., district, transferred to Morganfield, Ky., as assistant superintendent of production . . . **Gerald Layton**, drilling superintendent in Central district for British-American Oil Producing Company, transferred to Northwestern district with temporary headquarters at Sterling, Colo. . . . **Robert L. Cox**, district gauger, Interstate Pipe Line Company, Maysville, Okla., promoted to chief engineer at Hewitt station, replacing **Karl H. Ketter**, transferred to Cromwell station as chief engineer . . . **George W. Stage**, landman, Western division, United Producing Company, Charleston, W. Va., transferred from Liberal, Kansas, to Tulsa . . . **Pete Smith**, geologist with The Carter Oil Company, promoted from district geologist at Carmi, Ill., to division geologist at Mattoon, Ill. **Earl Cockrum**, formerly at Mattoon, transferred to Carmi succeeding Smith. **H. B. Bullard**, reservoir engineer, transferred from Purcell, Okla., to Oklahoma City.

•

**Jack Clarke** has been appointed director of public relations for Texas Eastern Transmission Corporation, and will supervise all public relation activities of the corporation, including financial and stockholder relations, publications and advertising.

Jack Clarke

Clarke was formerly assistant to the chairman of the board of Lion Oil Company, El Dorado, Ark., where he was in charge of public relations. He had previously been manager of Lion's Budget-Statistical department.

Clarke's offices will be in Shreveport, at the corporation's headquarters.

•

**James F. Ormond**, production department field engineer for Sunray Oil Corporation, Midland, Texas, has been awarded the National Safety Council's president's medal for his action in a recent emergency which is credited with saving the life of a Sunray employe.

Ormond will be awarded the medal by the Medal Administration Committee of the Council for successfully applying artificial respiration to a fellow workman, **Kenneth D. Mullings**, who inadvertently came in contact with an electrical wire carrying 12,700 volts of electricity, while working on a West Texas lease near Odessa.

Formal presentation of the medal and accompanying certificate will be made to Ormond at Sunray's annual West Texas district summer picnic.

•

**Stephen R. McGavran** has been appointed production engineer for the San Joaquin division of General Petroleum Corporation's Production department. McGavran has been with General Petroleum since June, 1948, having joined the company's Production department as a well puller immediately following his graduation from the University of Southern California where he received his degree in engineering.


Roughnecks in the Hole

Harbison-Fischer Heavy Duty Rod Pumps with Double-Thick * Barrel Tubes

* Sometimes operators just don't believe what we tell them about our line of heavy-duty subsurface pumps for deep wells . . . that the double-thick barrel tubes will not flex and bind the plunger . . . that long, one-piece barrel tubes eliminate installation of sectional-type pump bores which might shift out of alignment in long-stroke pumping . . . or that H-F heavy-duty pumps give hours on hours of dependable, trouble-free performance at 5,000 feet and deeper. There are other important features, too. For hard pumping, Tuff-Temper pump barrel tubes are heat-treated by our exclusive electronic process that produces a uniform, file-hardness for exceptional wearing qualities on the inner surface, yet allows the outer surface to remain ductile and shock-resistant. That's why we say, for economy's sake, don't equip another well until you get more information on these special deep-well pumps. Ask your supply store—or write us—for illustrated literature and other details. Harbison-Fischer Mfg. Co., Box 64, Fort Worth.

HEAVY-DUTY TUFF-TEMPER Rod Pump

Harbison-Fischer Precision HEAVY-DUTY Rod Pump

## MEN IN THE INDUSTRY NEWS

**C. G. Miller** has joined Delta Gulf Drilling Company as manager of the West Texas division, with offices in Odessa, Texas. **L. L. (Slim) Stanton** will continue as drilling superintendent for the district, in direct charge of the operation of the company's eight rotary rigs maintained in the area.

C. G. Miller

Miller was formerly in the Production department of Tide Water Associated Oil Company. He later joined the Texon Royalty Company, San Antonio, and was in charge of drilling rigs and production until 1947, when he became drilling and production superintendent for H. S. Moss, Dallas.

•

**M. Darwin Kirk, R. E. Foss** and **Harold W. Manley** have been named vice presidents of Sunray Oil Corporation. Kirk is also general attorney, Foss is general superintendent for the California production division, and Manley is in charge of the gas-gasoline manufacturing department.

Kirk was graduated in law from the University of Oklahoma in 1928, joined the former Barnsdall Oil Company in 1932, and was a vice president of that organization at the time of merger.

Foss was graduated from California Institute of Technology in 1932, joined Barnsdall in 1935 as petroleum engineer, and had been successively production foreman, drilling engineer and vice president for Barnsdall in 1945.

Manley was graduated in engineering from Oklahoma A. & M. College in 1929, joining Barnsdall that year, and had been successively roustabout, division engineer, production superintendent, and a Barnsdall vice president.

•

**Charles G. Cary** has been named superintendent of Freeport Sulphur Company's Louisiana district, Oil and Gas division. Cary joined the company in 1941 in connection with its sulfur operations and has been stationed in Louisiana continuously since that time, except for 2½ years during World War II when he served in the Navy.

Upon the formation of Freeport's Oil and Gas division, he became an administrative assistant to the manager of the division, and has been stationed in New Orleans. As superintendent of the Louisiana district, he will continue to maintain his office there.

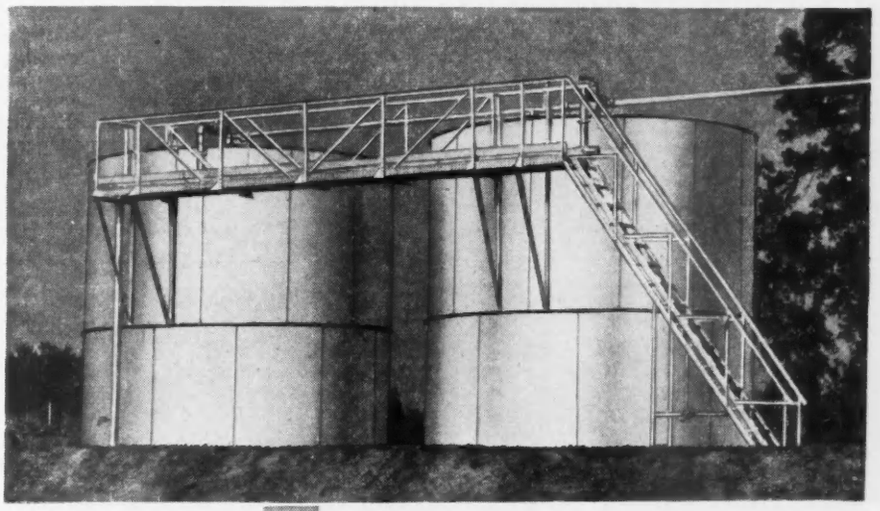
•

**Charles W. Day, Jr.**, has been appointed superintendent of land for Sohio Petroleum Company, and **George R. Bixler, Jr.**, has been named division landman for the Southern division at Houston. Bixler was formerly assistant division landman and succeeds Day in his former position.

Day joined Sohio as district landman at Shreveport in 1944. He is a graduate of Washington and Lee University and received a law degree from Tulsa University.

Bixler, a graduate of the University of Oklahoma law school, joined Sohio in August, 1947.


# Butler "Extras" Give You Longer Lasting Tanks!



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**V. J. Sittell** has been named assistant chief engineer of Service Pipe Line Company. Sittell succeeds **Sam L. Jackson**, Tulsa, who resigned to join Standard Oil Company (Indiana) as assistant manager of the Products Pipe Line department.

•

**Kenneth M. Lawrence**, Amerada Petroleum Corporation, Tulsa, has been promoted to chief geophysicist.

•

**Henry Pope Dodge** has retired as district landman of Magnolia Petroleum Company's Wichita Falls district, and has been succeeded by **Marvin S. Jones.** Dodge began his career with the organization in February, 1910, approximately a year before Magnolia Petroleum Company was founded as such. At the time he was employed he was with Corsicana Petroleum Company, a predecessor company of Magnolia.

**Webb B. Cooley** has been appointed manager of Magnolia Petroleum Company's Ad Valorem Tax department, succeeding the late **A. D. Nelson. G. R. Alexander** has been made assistant manager of the department.

•

**W. S. Crake** has been appointed division manager of Shell Oil Company's East Texas producing operations. He succeeds **O. L. Dale,** who takes Crake's place as chief mechanical engineer in the Houston area.

•

**Roger Lewis** has joined the petroleum engineering firm of Cable & Stine, Wichita Falls, Texas. Lewis, who was previously with the U. S. Bureau of Mines, participated in a study of the southwest part of the Kamay, Texas, field. The study reviewed the effectiveness of the pressure maintenance project which has operated in that field for a number of years. Lewis is a graduate of the University of Texas in petroleum engineering.

Roger Lewis

•

**Travis M. Kerr** and **F. C. Love** have been appointed secretary and treasurer, respectively, of Kerr-McGee Oil Industries, Inc., Oklahoma City, succeeding the late **T. W. Fentem.**

•

**George C. Merrick** has been named industrial relations supervisor for Stanolind Oil and Gas Company's Texas-Louisiana Gulf Coast division, Houston. He was formerly industrial relations supervisor for Stanolind at Brownsville, Texas.

•

**Henry A. Spencer,** formerly with Petroleum Exploration Company, has been named head of the Land department for Winmar Oil Company, with headquarters at Princeton, Ind.

•

**E. O. Markham** has resigned from the geological staff of The Carter Oil Company after 30 years' service. He will open consulting offices in Tulsa.

•

**F. T. Hopp,** secretary and treasurer of Skelly Oil Company, Tulsa, has retired after 30 years in the oil business. He is succeeded by **C. L. Swim.**

•

**M. S. Keffer,** Stanolind Oil Purchasing Company, has been appointed crude oil buyer in the West Central Texas district, with headquarters in Abilene, Texas.

•

**Jim McGuirt,** formerly division geologist for Tide Water Associated Oil Company, has joined Austral Oil Exploration Company, Houston.

•

**Dean White** has resigned as district geologist for Placid Oil Company at Shreveport, to become a consultant there.

•

**William P. Gee,** vice president of Texaco Development Corporation, has been promoted to the position of assistant to the president of The Texas Company. Gee entered the oil business in 1919 and has been with The Texas Company since 1927.

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## MEN IN THE INDUSTRY NEWS

**Vernon Taylor,** formerly operations manager of the producing department for Imperial Oil Limited at Toronto, has been transferred to Calgary and has been succeeded by **E. D. Wilson,** formerly division petroleum engineer at Calgary.

•

**R. J. Gutru** has resigned as district geologist in Kansas for Champlin Refining Company, and is now with Beardmore Drilling Company at Wichita.

•

**Gail Nusbaum** has resigned from Champlin Refining Company, Enid, Okla., to become a consultant. He had been with the company 30 years.

•

**Charles B. Johnson, Jr.,** formerly chief engineer, has been named manager of production and drilling operations for The Chicago Corporation. **Roy A. Schuster,** formerly general superintendent of plants, has been promoted to manager of plant operations. Both have headquarters in Corpus Christi.

**A. F. Morris** has been appointed chief geologist, and will have headquarters in the corporation's new offices in the Continental Life Building, Fort Worth. Morris was formerly on the geological staff of Cities Service Oil Company.

•

**Bryan O. Bishop** has joined the North Basin Pools Engineering Committee and has his headquarters in Denver City, Texas. Bishop is a petroleum engineering graduate of the University of Oklahoma. **Mrs. Bryan O. Bishop** has resigned her position with Anderson-Prichard Oil Corporation, Oklahoma City, where she was in charge of drafting.

Bryan O. Bishop

•

**Arthur E. Erickson** has resigned from Phillips Petroleum Company and is now chief geologist at Tulsa for Northern Natural Gas Company of Omaha.

•

**Guy H. Woodward** has resigned as Mid-Continent Oil and Gas Association representative in Washington, D. C., to join Noble Drilling Company at Tulsa.

•

**David E. Waggoner,** formerly of Taft, Calif., has joined Diamond Oil Well Drilling Company at Oklahoma City as service engineer.

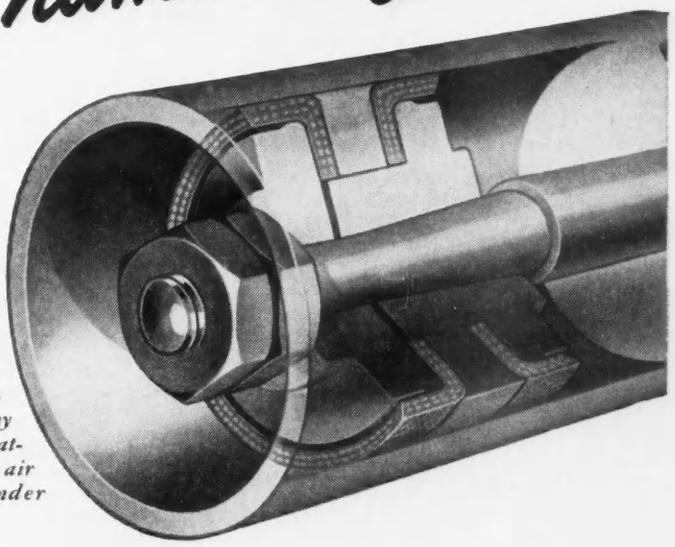
•

**James H. Lieber** has joined the civil engineering department, Magnolia Petroleum Company, Oklahoma City.

•

**Eddie Bell,** formerly with Loffland Brothers, has joined Stansbury, Inc., drilling contractor of Bakersfield, Calif. He replaces **Francis Kee,** resigned. **E. R. Love,** general superintendent, has also resigned.


*You name the fluid...*



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**PUMCUPS**

**Edmund L. Buckley**, independent oil producer and a pioneer in the oil development in Tampico, Mexico, died March 14 in Houston. Buckley attended the University of Texas school of petroleum engineering and the University of Mexico law school. He had made his home in Tampico since 1913, but also maintained a Houston office.

•

**Lloyd Nash**, 57, landman for Tide Water Associated Oil Company, died March 17 in Midland, Texas.

•

**Roy E. Poe**, 63, of Tulsa, president of the Reese Drilling Company and the Tiger Mountain Oil Company, died April 4. He was a brother of the late **E. Holley Poe** who died last March 9.

# DEATHS

**H. L. Hargus**, 55, paymaster for The Carter Oil Company, Tulsa, died March 18. He had been with Carter and affiliated companies at Shreveport and Tulsa for more than 30 years.

•

**George Ellsworth Bennett**, 87, pioneer Tulsa oil man, died April 8. He served at one time as secretary to Col. John J. Carter, founder of The Carter Oil Company, and was also treasurer and general auditor for The Pure Oil Company.

**Ace Gutowsky**, 64, prominent Oklahoma oil operator credited with the discovery of the West Edmond, Okla., oil pool, died April 4 in Oklahoma City. He had recently moved to McAllen, Texas, where he operated extensive agricultural holdings in the Rio Grande Valley.

•

**A. D. Nelson**, 60, manager of the Ad Valorem Tax department of Magnolia Petroleum Company, died February 28 in Dallas.

•

**Fred M. Hughes**, 55, an employe of Humble Oil & Refining Company's Accounting department since 1919, died March 17 in Houston.

•

**Mrs. Zelie Marie Willson**, 80, one of the developers of Spindletop oil field, died March 25 in Houston. Mrs. Willson was the principal owner of the Gladys City Oil & Gas Company of Beaumont.

•

**J. F. Reagan**, 68, retired independent oil producer, died March 26 in Tulsa.

•

**Jack Runnels**, retired Sun Oil Company employe at Nederland, Texas, died February 16. He had been with Sun since July, 1930, and retired in December, 1949.

•

**Max B. Miller**, 64, president of Max B. Miller & Company, Inc., petroleum engineers, died March 31 in New York City.

•

**Miller Voss**, 58, an employe of Humble Pipe Line Company for 30 years, died April 3 in Houston.

•

**I. L. Dunn**, 81, founder of Dunn-Lewis Consulting Petroleum Engineers, Tulsa, died April 9. He retired from active work in 1940.

•

**Thomas Clarkson**, 77, retired petroleum technologist formerly with Standard Oil Company, died April 15 in Tulsa.

•

**John P. McNutt, Sr.**, 70, partner in McNutt and Davis Drilling Company and well-known Oklahoma independent, died April 4 in Okmulgee, Okla. He had been retired since 1945.

•

**F. C. Asher**, Sun Oil Company foreman, Snyder, Texas, died February 1. The 21-year Sun veteran started with the company as a gang pusher-pumper in McCamey, Texas, in 1929.

•

**H. H. Phillips**, 54, independent oil man, died March 16 at Chickasha, Okla.

•

**F. H. Oglesby**, an employe since 1925 of the Pipe Line division of Cities Service Gas Company, died March 20 in Winfield, Kansas.

•

**Arthur E. King**, 71, president of Flag Oil Company and vice president and general manager of Southwestern Cotton Oil Company, died March 30 in Oklahoma City.


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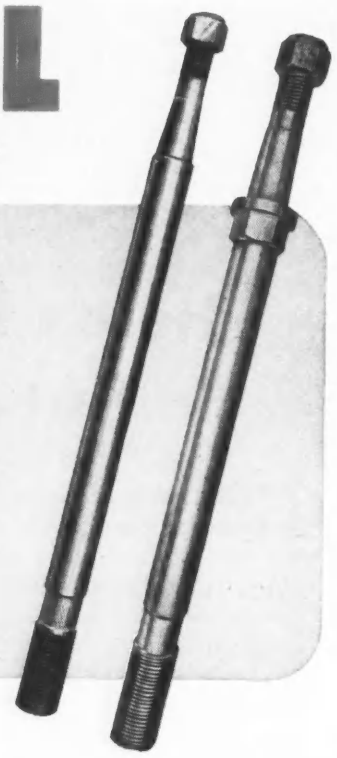

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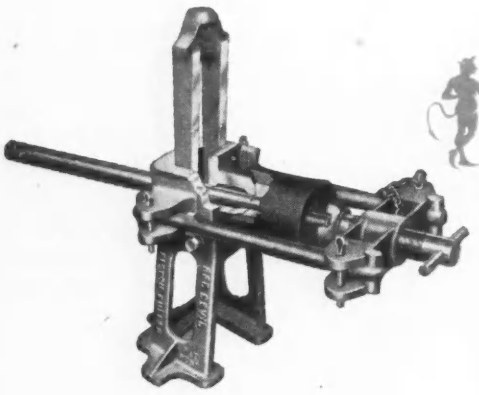

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The usual practice of removing pistons from rods by blows of a sledge hammer often damages either pistons or rods. A Red Devil piston puller easily and quickly removes badly stuck pistons without injury to either part. All elements are made of finest quality alloy steel, heat-treated for strength and long life. Write for Catalog No. P-106.

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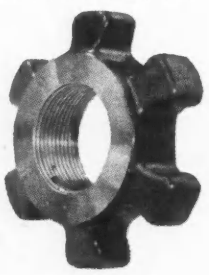
Complete information in Composite Catalog or write for price catalogs noted above. Red Devil products are available through your supply store.



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# Associations

At center, seated, is Harold E. Berg, new chairman of the API Mid-Continent District, and at right, seated, is Glenn M. Stearns, chairman of the district advisory committee. Standing, left to right, are V. J. Mercier, district secretary-treasurer, and Vern Morris, vice chairman for southwestern Oklahoma. Seated at left is Fred J. Neslage, API Panhandle Chapter chairman and one of the hosts for this year's Amarillo session.

## Berg Is Elected Chairman of Mid-Continent District API

Harold E. Berg, division production superintendent, Tide Water Associated Oil Company, Tulsa, is the new chairman of the Mid-Continent District, American Petroleum Institute, Division of Production, succeeding Dr. Glenn M. Stearns, chief engineer, British-American Oil Producing Company, Tulsa. He was chosen at the 22nd annual meeting held at Amarillo, Texas.

Other new officers are W. D. Maxwell, superintendent, The Carter Oil Company, Great Bend, Kansas, re-elected vice chairman for Kansas; F. J. Wilbanks, Bethlehem Supply Company, Seminole, Okla., vice chairman for northern Oklahoma; Vern Morris, Sohio Petroleum Company, Pauls Valley, Okla., vice chairman for southwestern Oklahoma; J. Max Harbison, Kewanee Oil Company, Pampa, Texas, vice president for the Panhandle region; T. C. Stauffer, Sun Oil Company, Evansville, Ind., vice chairman for southern Illinois, southwestern Indiana and western Kentucky; V. J. (Mike) Mercier, Perforating Guns Atlas Corporation, Wichita, Kansas, secretary-treasurer. Stearns becomes chairman of the advisory committee succeeding J. H. Field, Sohio, Oklahoma City.

Wichita was selected for the 1952 meeting of the district.

Citations for exceptional service in past years were presented to H. E. Zoller, Derby Oil Company, Wichita; L. A. Ogden, The Pure Oil Company, Tulsa; Harold S. Kelly, Phillips Petroleum Company, Bartlesville, Okla.; William L. Horner, Sunray Oil Corporation, Tulsa; W. E. Best, consulting engineer, Pauls Valley; Lloyd E. Elkins, Stanolind Oil and Gas Company, Tulsa; and R. C. Kay, independent operator, Amarillo.

## Regional NACE Will Meet

The annual meeting of South Central Region, National Association of Corrosion Engineers will be held October 18, 19, and 20 at Corpus Christi, Texas. George A. Mills of Central Power and Light Company, Corpus Christi, is general chairman of the meeting.

## Petroleum Library Established

Ark-La-Tex Geophysical Society, Shreveport Geological Society, and the East Texas Chapter of AIME have completed preliminary plans for a Petroleum Exploration Library to be housed in the Shreve Memorial Library, Shreveport. A drive is now being made to obtain books and publications pertaining to the oil and gas industries. Contributions should be sent to Harry Buckner, in care of The Carter Oil Company, Shreveport.


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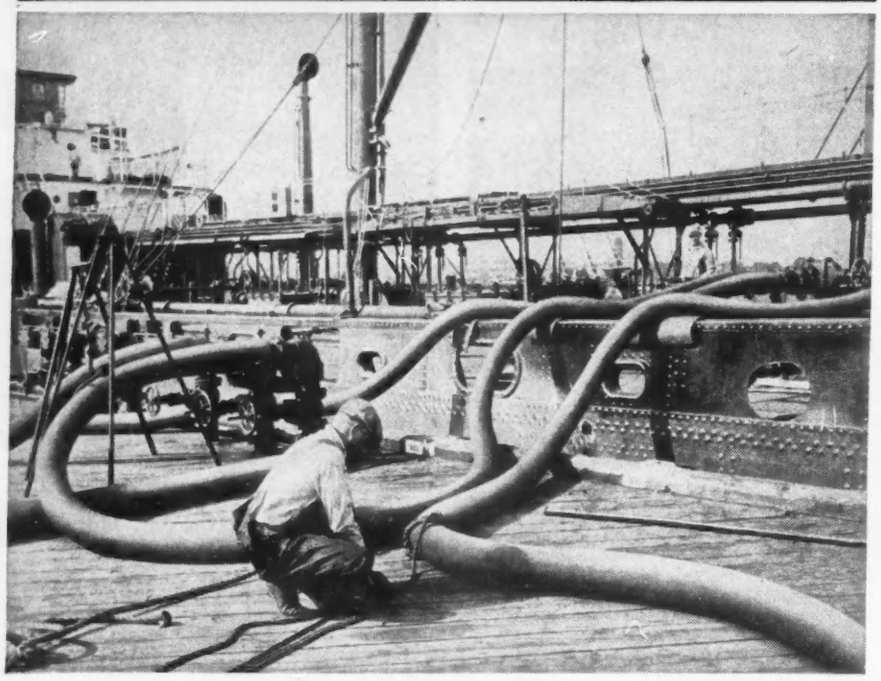

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## ASSOCIATIONS

### *Pacific Coast District API Holds Spring Meet May 10-11*

The Pacific Coast district of the API will hold its annual spring meeting May 10-11 at the Biltmore Hotel, Los Angeles. Paul Andrews, Signal Oil and Gas Company, is general chairman.

Technical papers on drilling and producing operations will be read at the morning and afternoon sessions. The banquet is scheduled for Thursday evening, May 10.

Among those named by Andrews to handle preparations for the meetings are W. F. Bates, Shell Oil Company, chairman of drilling session; J. O. Hills, General Petroleum Corporation, vice chairman; T. H. Acres, Sunray Oil Corporation, chairman of production session; C. F. Gates, general petroleum, vice chairman; H. L. McCarty, Union Oil Company of California, vice chairman; C. R. Ball, Ball & Black Supply Company, chairman of arrangements.

### *AAPG President's Award Won By Two Creole Geologists*

Walter B. Spangler and J. J. Peterson, Creole Petroleum Corporation, Caripito, Venezuela, are 1951 winners of the American Association of Petroleum Geologists President's award for the most significant original contribution to petroleum geology published in the AAPG Bulletin during the previous year by an author under 35 years of age. The winning paper is "Geology of Atlantic Coastal Plan in New Jersey, Delaware, Maryland and Virginia."

### *Petroleum Consultant Joins Midwest Research Institute*

Dr. Frank C. Fowler, formerly of the University of Oklahoma faculty, has joined the staff of Midwest Research Institute, Kansas City, as petroleum consultant. Fowler will conduct investigations in petroleum and allied fields for the institute. He attended the universities of Illinois and Michigan, and received the Ph.D. degree from the latter school in 1943. He was employed by Phillips Petroleum Company, Bartlesville, Okla., from 1943 to 1946, when he joined the University of Oklahoma faculty.

### *French Petroleum Engineers Will Study Industry in U. S.*

Eleven of France's leading petroleum engineers will arrive in May for a nine-month study of the U. S. petroleum industry. Dr. W. A. Cunningham, University of Texas chemical engineering professor, will direct their work, which will include in-service training in the petroleum industry and attending advanced classes and seminars at various universities. The program is sponsored jointly by the Economic Cooperation Administration and the French government.

French engineers who will take part in the program are Francois Kermarrec, Jean Rochet, Jacques Schoeffler, Claude Joie, Michel Mangeon, Andre Rey, Robert Dolez, Bernard Leboucher, Louis LeGuern, Claude Richard, and Francis Etienne Heritier. Each has from one to 14 years of petroleum industry experience.

## ASSOCIATIONS

### NACE Will Publish Abstracts Of Literature on Corrosion

Abstracts of corrosion literature will be printed by the National Association of Corrosion Engineers on McBee punch cards to reduce time needed to search literature for information. The 5x8 inch cards on which abstracts are printed have two rows of holes around their perimeter, most of which have been allocated to the NACE Abstract Filing System with the necessary indices printed adjacent to the holes. The remainder of the holes are left open for supplementary indexing by subscribers to the card service who wish to add their own system. McBee cards are sorted by pushing needles through designated holes, lifting the stacks and shaking out the desired cards.

The index system consists of eight main subjects: General, Testing; Types, Factors and Theory; Environments, Preventive Measures, Materials of Construction, Equipment, Industries. Within the main divisions are seven to 10 subdivisions, and within each subdivision, several subclassifications.

Further information on the NACE Abstract Card Service may be obtained by writing the National Association of Corrosion Engineers, 919 Milam Building, Houston 2, Texas.

### Investigator Will Aid Fight Against Oil Equipment Thefts

Fred H. Prestage, Wichita Falls, district supervisor for the Texas Liquor Control Board, was named special investigator for the Texas Mid-Continent Oil and Gas Association's theft prevention program.

Fred H. Prestage

An ex-sheriff and wartime military police investigator, Prestage will assist Chief Investigator George W. Robey of Coleman in the association's joint effort with police authorities to stop theft of oil field equipment.

### California Stripper Well Group Re-Elects V. L. Norman

Victor L. Norman, California independent oil man, has been re-elected to his fourth consecutive term as president of the California Stripper Well Association. Edwin P. Crail, president of Victory Oil Company; Laurence A. Donnelly, vice president of Exeter Oil Company, Ltd.; and Decatur Mitchell, president of Coast Supply Company, were re-elected vice presidents; Thomas H. Work, Nordon Corporation, Ltd., was re-elected secretary-treasurer; and Richard Fenton, executive vice president of the association since its organization 12 years ago, was also re-elected.

### Committees Set Meeting

The Standardization and Standing committees of the API division of Production will hold their midyear meeting in the Brown Palace Hotel, Denver, May 28 through June 1, 1951.


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**Southwestern Oil Men** who were honored for their outstanding service by the Southwestern district API Production division are pictured. Left to right, first row, are R. O. Garrett, Arkansas Fuel Company, Shreveport; A. G. Levy, oil consultant, Houston; E. P. Hayes, The Texas Company, Houston; D. V. Carter, Magnolia Petroleum Company, Dallas; John A. Ritter, Sun Oil Company, Dallas; R. E. Bridges, Humble Oil & Refining Company, Houston. Second row: C. E. Sutton, The Pure Oil Company, Houston; W. E. Winn, Ashland Refining Company, Dallas; B. J. Dowd, Union Producing Company, Shreveport; E. P. Hubbard, Gulf Oil Corporation, Houston; W. V. Vietti, The Texas Company, Houston; W. T. Doherty, Mound Company, Houston. Not pictured are R. B. Kelley, Pure, Fort Worth; and W. S. Morris, East Texas Salt Water Disposal Company, Kilgore, Texas. The honorees are men who served as API district chairmen during the period 1928-1948.


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These lines are easy to order. Just specify Tuffy ***Jackknife*** Rotary Line or Tuffy ***Standard*** Rotary Line, the length of line and the size. Nothing else is necessary.

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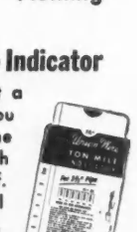
Union Engineers have worked out a ton-mile indicator that helps you measure the work your rotary line has done and helps you establish proper frequency for cutting off. This Ton-Mile Indicator does all the complicated figuring for you. It is simple to use, and with it, you get a new Union Log Book in which to keep your well records.



**union Wire Rope corporation**

2104 Manchester Ave. Kansas City 3, Mo.

Gentlemen: Please have your fieldman deliver my Union Wire Ton-Mile Indicator and log book, and show me how easy it is to use.

NAME_____

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CITY_____ ZONE____ STATE_____


## *Intermountain Geologists Plan Second Utah Field Conference*

Intermountain Association of Petroleum Geologists will conduct its second annual field conference, to be held in the canyon, House and Confusion Range areas, Millard County, Utah, May 23-26. The conference committee is under the direction of Graham Campbell, Phillips Petroleum Company, and a guide book is being prepared under the editorship of Dr. William L. Stokes of the University of Utah.

Inquiries should be addressed to H. V. W. Donohoo, secretary, IAPG, Geophysics Department, University of Utah, Salt Lake City.

## *AAODC Plans Safety Clinic To Be Held in Dallas May 3-4*

The Sixth Annual Safety Clinic of American Association of Oilwell Drilling Contractors will be held at the Baker Hotel, in Dallas, May 3 and 4. Plans for this meeting, which is a feature of the association's safety program, were announced by H. W. Davidson, Davidson Drilling Company, Odessa, Texas, Chairman of the AAODC Safety Committee. The program for the two-day session will include many practical aspects of safety in the drilling industry.

## *Producers Promote Fox*

Stark Fox was elected a vice president of Oil Producers Agency according to an announcement by Rush M. Blodget, executive vice president. Fox joined the Agency in 1937 and has been with the organization continuously ever since, except for a three-year period during the war, when he was an air combat intelligence officer in the Navy. Prior to his association with Oil Producers Agency, he was on the editorial staff of a California oil trade publication.

## *Heads Michigan Association*

I. W. Hartman, Mount Pleasant, Mich., has been elected president of the Michigan Oil and Gas Association.

## General Petroleum Surveyor Heads Right-of-Way Society

William C. Meek, chief surveyor of General Petroleum Corporation's Right of Way Department, has been elected president of the Los Angeles chapter of the American Right-of-Way Association.

Meek is the third oil man ever to be elected to the presidency of the number one chapter of the association. R. I. Plomert, Jr., and J. J. Schillinger, both also General Petroleum executives, are past-presidents.

Meek has been with General Petroleum since 1940.

## Field Conference Planned

The Fifth Annual Field Conference on the Pennsylvanian geology and mineral resources of western Indiana will be held May 11-13. The conference, sponsored by the Department of Geology, Indiana University, and the Division of Geology, Indiana Department of Conservation, is under the direction of Ralph E. Esarey, professor of petroleum geology.

## Schulte Joins LP-Gas Staff

George J. Schulte, Jr., has been appointed assistant director of the LP-Gas Information Service, Chicago, and will assist in the publicity and administrative phases of the national LP-Gas promotional program launched early in 1950 by the liquefied petroleum gas industry. A journalism graduate of the University of Missouri, Schulte has been engaged in publicity and publication work for more than ten years.

## Committee Leaders Named

Harry Trower, retired vice president of Phillips Petroleum Company, and J. B. Smith, vice president of Vickers Petroleum Company, Wichita, Kansas, will head the Kansas-Oklahoma Oil Industry Information Committee during 1951.

## Heads Oil Field Shippers

R. J. Andress, vice president for traffic, Service Pipe Line Company, Tulsa, has been reelected chairman of the Shippers Oil Field Traffic Association for a third term. Other officers reelected include W. W. Klingensmith, traffic manager, Tulsa Chamber of Commerce, secretary-treasurer, and T. M. Moore, traffic manager, The Atlantic Refining Company, Dallas, co-chairman.

## Equipment Suppliers to Meet

The 16th annual membership meeting of the Petroleum Equipment Suppliers Association will be held June 17-20 at the Chateau Frontenac, Quebec, Canada. Walter F. Pusch, supervisor of PESA's Pacific district office, will handle all accommodations.

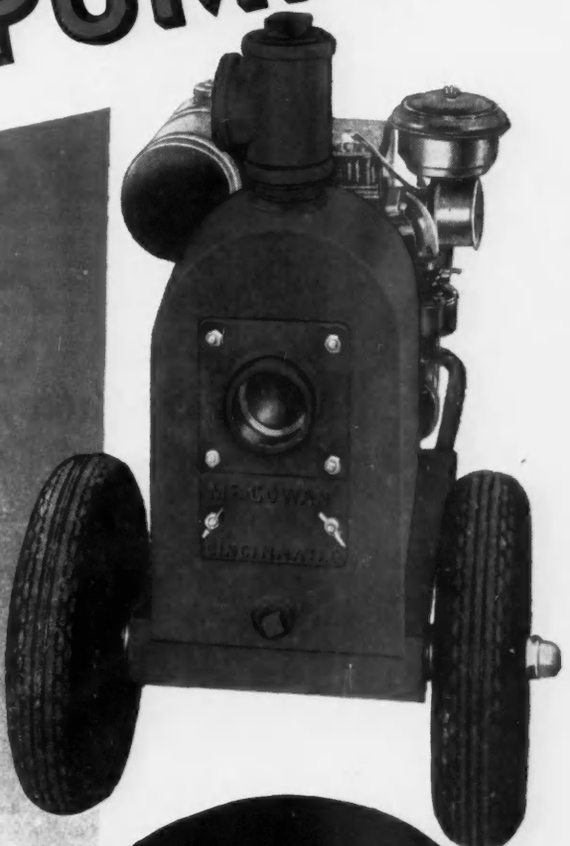
## Illinois Basin API Elects

T. C. Stauffer, Evansville, Ind., manager of Sun Oil Company's Central Production division, has been elected chairman of the Illinois Basin Chapter, API. John P. Bassett, Sun departmental supervisor at Evansville, was named secretary-treasurer.


best for the job

• SELF PRIMING
• CENTRIFUGAL

McGOWAN PUMPS



These rugged McGOWAN all welded steel pumps are lighter, yet stronger, more durable than any you've ever seen. Now in operation in Oil Fields throughout the world. They feature — automatic priming • non-clogging impeller hardened wear plates • large access plates • tested and trouble free shaft seals.

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McGOWAN PUMPS

Long life service means extra economy! McGowan Pumps have been serving the Industry since 1852. See your Supply Co. or write today for catalog sheets, complete information.

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LEYMAN MANUFACTURING CORP.
PUMPS
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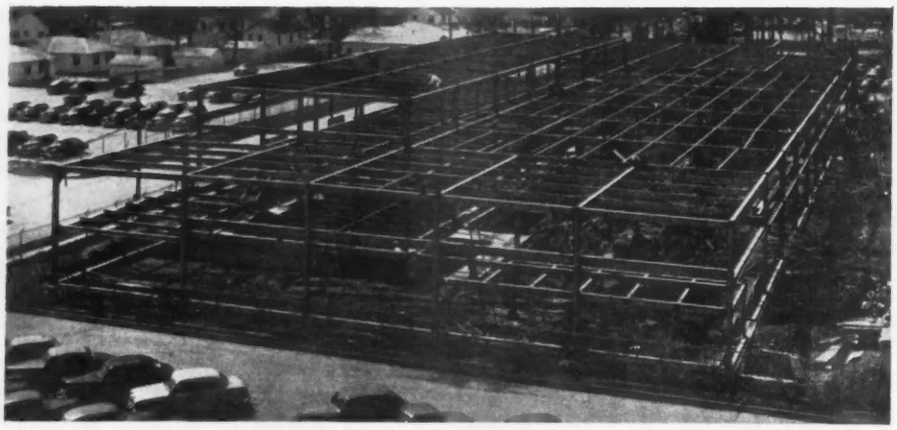
McGOWAN PUMP DIV., Leyman Mfg. Corp.
58 Central Ave., Cincinnati 2, Ohio
Please send without obligation data on McGowan self priming centrifugal pumps.

COMPANY_____
NAME_____
ADDRESS_____

# EQUIPMENT AND SERVICE SUPPLIERS' NOTES



Structural steel work for Hughes Tool Company's Engineering Laboratories building had been completed when this picture was taken in early April.

### *Construction Progresses on Hughes' $2 Million Engineering Laboratories*

Scheduled for completion by June of this year, construction of Hughes Tool Company's new $2 million Engineering Laboratories building in Houston is moving forward rapidly.

The new laboratories building, two stories in the center, covers 75,000 square feet. When completed it will house the metallographic laboratory and offices, chemical laboratory, emission spectrum laboratory, projection room and library, welding laboratory and machine shop, and mechanical testing section. The field-size drilling rig, now being used to carry on research in design and rock bit performance, will be moved from its present location to the northeast corner of the new building. The building and rig will be completely air conditioned.

Hughes Tool Company opened the drilling industry's first rock bit laboratory in 1911 and has carried on research in this field on a continually increasing scale since then.

The Engineering Laboratories are under the direction of Dan Martin, vice president-engineering, who supervises all of Hughes Tool Company's engineering activities. Included in the laboratory division are Research Engineering, headed by Floyd Scott, chief research engineer; Production Research Engineering, directed by Lyle Payne, chief engineer, and Metallurgical Engineering, under Robert Schlumpf, chief metallurgist. The administration of the Engineering Laboratories is the function of Metallurgical Engineering Department.

The new laboratories will carry on research in design, metallurgy and product improvement. In their search for better materials the Hughes laboratories will be assisted by Armour Research Foundation and Battelle Memorial Institute.

A half-million dollars will be expended for new laboratory machines, technical apparatus and equipment to supplement that being moved from the company's present laboratory.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Acme

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PETROLEUM EQUIPMENT SUPPLIERS' ASSOCIATION MEMBER

. . . to-be-Sure — Always Ask for Acme's Alloy Bits...

A most reasonable extra FIRST cost buys you ½-century's biggest bit buy. Delivers 50% or more actual in-hole action than any "regular" bit. Acme "Drilmor" ALLOY meets the increasing demand for a new type bit fully capable of cutting HARDEST formations; assuring more in-hole time.

Another feature (saving wasted out-time) is that Acme's Alloy Bit can be dressed and tempered in the field. And without special equipment; like "regular" bits. EXTREME, deeper penetrating hardness makes Acme's non-competitive Bits hold cutting edge, wear longer, resist battering, even in toughest going. They're longer life bits for your longer profit.

Write NOW for Alloy Bit's full facts and your copy Acme's latest Cable Tool Catalog — containing proper field treatment of bits.

Fig. 108AA. Acme Alloy Bit. 51-years' specialized "know-how" makes it worth more to YOU.

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ACME FISHING TOOL CO. PARKERSBURG W. VA.

Export Office:
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### *Emsco Moves D+B Division Offices To Manufacturing Plant at Garland*

D+B Division, Emsco Derrick & Equipment Company, is transferring its executive, engineering, advertising, pricing and export offices to the company's new plant at Garland, Texas. D+B Mid-Continent sales offices were previously there.

W. C. Kinder

William C. (Bill) Kinder, vice president in charge of the D+B Division, was recently moved from Los Angeles to Garland. Others will follow shortly.

The Garland plant was completed 18 months ago. Sales of D+B products are distributed exclusively through the Continental Supply Company, Dallas, in the Mid-Continent area and export. California distribution is handled direct through a series of stores located in the more important producing areas.

Kinder has been with D+B Division, Emsco Derrick & Equipment Company since 1939, when he joined that group after spending six years with the Republic Supply Company of California handling subsurface pumping equipment sales. He has directed D+B operations since 1941.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Baroid Sales Division Employes Are Promoted to Key Positions*

Baroid Sales Division of National Lead Company has announced the appointments of J. J. Doyle as purchasing agent; R. C. Marr as manager of Product Procurement department; E. L. Mohr as general superintendent, Pacific Coast division; and F. T. Gregory as manager of Transportation and Testing equipment departments.

R. C. Marr

J. J. Doyle

E. L. Mohr

Marr, a graduate chemical engineer, joined the Baroid Sales Division in Houston in 1936 and then went to Tulsa to manage the laboratory. In 1938 he became field service engineer for Oklahoma. In January, 1940, he returned to Houston as manager of the Houston laboratory, which position he continued to fill until February, 1943, when he became assistant division manager, Gulf Coast division. On April 1, 1945, he became manager of the Transportation department, and shortly thereafter his duties were enlarged to include the management of the Testing Equipment department. As manager of the Product Procurement department Marr will continue to have general supervision of the Transportation and Testing Equipment departments.

Doyle started with Baroid in 1939, as chemical engineer in the Houston laboratory. He entered military service in 1941, and returned to Baroid in November, 1945, to become development engineer for the Testing Equipment and Transportation departments. On March 1, 1950, he joined the Field Service division as an engineer on the Gulf Coast. He serviced wells in the area around Houston until his appointment as purchasing agent.

Mohr was first employed by Baroid in 1941 as a well logging engineer. He became a field service engineer in December, 1943, servicing oil wells in the Bakersfield, Calif., area until November, 1945. A short absence followed, after which Mohr returned to continue his work as a field service engineer on the Pacific Coast. On January 1, 1947, he became superintendent of districts 53 and 54.

Gregory entered Baroid service March 1, 1946, as chief clerk of the Transportation and Testing Equipment departments. He became assistant manager of these departments on January 1, 1950.


# The best fire-fighting foam is Air Foam!

# FREE AIR FOAM REFERENCE CATALOG

## Air Foam is more effective, less expensive than chemical foam

Pyrene* Air Foam is the finest fire protection yet devised for oil fire hazards. It extinguishes fast, prevents flash-backs and re-ignition, is *compact* and extremely flexible. Pyrene* Air Foam is available in America's most complete line of portable, fixed, and mobile units, for any size hazard. In most instances, they can be operated by one man! Installation and upkeep costs are almost always lower than those for chemical foam. And foam compound costs less.

If your firm must cope with the danger of oil fire hazards, you owe it to yourself to study the Pyrene reference catalog, and have the information in it available at your fingertips. Send for your copy today—without any obligation, of course.

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**MAIL COUPON TODAY!** It will bring a valuable FREE reference booklet illustrating and describing air foam equipment for every type of oil fire hazard.

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Company_____

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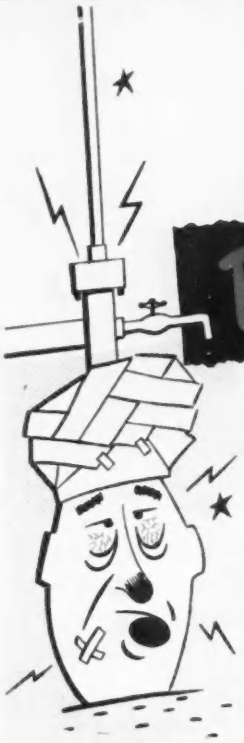
City_____ Zone____ State_____

**Domestic and Foreign** sales representatives of The Guiberson Corporation are pictured at the company's three-day sales meeting in Dallas. Discussions of proposed new equipment and improvement of present oil field equipment highlighted the meeting, company officials said. Left to right, in the front row, kneeling, are R. L. Lindsay, Wichita Falls; C. E. Lance, Seminole; H. M. Cherry, Houston; L. T. Ferguson, Evansville; E. W. Nolan, Jr., Odessa; R. Z. Mendenhall, Victoria; E. L. Kilgore, Alice; D. L. Fry, Hobbs; S. D. Beckley, New York. Back row, standing, R. L. McAdams, Lafayette; R. J. Foreman, Lafayette; A. E. Brummett, Houma; B. M. Matthews, Houston; C. L. Forcum, Longmont; O. A. Hess, Dallas; G. P. Thomson, Longview; H. S. Zane, Jr., Dallas; D. B. Craver, Kilgore; A. P. Smith, Dallas; D. L. Moss, Odessa; R. H. Washburn, Houston; Frank Bridwell, Abilene; E. E. Embury, Los Angeles; J. P. Killingsworth, Duncan; C. A. Teel, Odessa; R. A. Day, Oklahoma City; J. T. Anderson, Brownfield; D. L. McGill, Dallas.

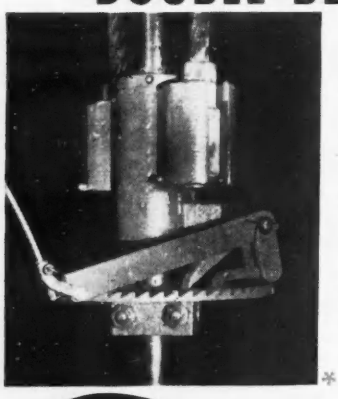



# A SURE CURE for PARAFFINITIS*

**There is no need to put up with this malady . . . no need to give your wells frequent and costly treatments of steaming out or pulling the rods to remove paraffin and maintain production.**

**Huber Paraffin Scrapers are a permanent cure for paraffin accumulation. Attached to the sucker rods, they wipe the tubing walls clean of paraffin. The scraper blades are shrink-fitted to the rods which are rotated by the Huber Rotating Rod Hanger. Wiping action takes place as the string is rotated and reciprocated.**

## DOUBLE BENEFIT ROTATION



The combined rotating and reciprocating motion wipes paraffin from the tubing in particles so small they go out in solution . . . can not clog tubing, scrapers, or flow lines. Rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equalizing wear on working barrel. Get this added benefit while eliminating paraffin accumulation by installing Huber Scrapers and Huber Rotating Rod Hangers.

Cure your wells of paraffin accumulation . . . install Huber Paraffin Scrapers and Rotating Rod Hanger, NOW!

* Congestion caused by the accumulation of paraffin in pumping wells.

*For further information see your local supply store, or write*

**J. M. HUBER CORPORATION,**
Box 831 . . . . . Borger, Texas

HUBER

**PARAFFIN SCRAPERS**

SCRAPE AS THEY ROTATE AS THEY RECIPROCATE


## *Rocky Mountain Division Transfers And Promotions Made by Halliburton*

Lockie Gillham

J. W. Hall

Halliburton Oil Well Cementing Company has promoted J. W. (Bill) Hall to assistant division manager of the Rocky Mountain division. In other Rocky Mountain division assignments, Lockie Gillham has been placed in charge of Halliburton operations in Newcastle and Lance Creek, Wyo., and Frank King has been promoted to fieldman in charge of operations in Lovell, Worland, and Powell, Wyo., and Cut Bank and Roundup, Mont.

Frank King

Hall, whose new headquarters will be in Casper, Wyo., was formerly district superintendent in the West Texas division. He joined Halliburton at Abilene, Texas, in 1937.

As district superintendent, Gillham's headquarters will be in Newcastle, Wyo. He has been with Halliburton 14 years, and was formerly stationed at Hugoton, Kansas.

King, who was formerly a cementer at Lance Creek, will have headquarters at Lovell. He joined Halliburton in 1926 and has worked in most of the larger oil fields in the Mid-Continent and Rocky Mountain areas.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Oil Center Tool Company Announces Two Changes in Sales Organization*

A. M. Taylor

C. B. Wright

Two changes in the Oil Center Tool Company sales organization have been announced by Rex Galloup, O-C-T sales manager.

A. M. Taylor, formerly with Bethlehem Supply Company in Oklahoma, has been added to the O-C-T sales organization and will make his headquarters in Oklahoma City.

C. B. Wright, formerly in the O-C-T Oklahoma City sales office, has moved to Dallas. He will serve the North Texas territory from his Dallas headquarters.

### *Dowell Incorporated Names Williams To Oil Field Products Sales Position*

Guy F. Williams, Tulsa, has been promoted from assistant sales manager to sales manager, Oil Field Products division of Dowell Incorporated.

Guy F. Williams

Williams, who has been with Dowell since 1936, was named assistant sales manager in July, 1946. He has been in Tulsa since 1947 working with product sales.

Before going to Tulsa, Williams served with Dowell as a treating engineer in Mt. Pleasant, Mich.; Seminole and Great Bend, Kansas.

A new district laboratory has been opened by Dowell Incorporated in Midland, Texas, to operate as a branch of the main Chemical Research Laboratory in Tulsa. The Midland laboratory is equipped for complete testing of all types of oil field samples such as cores, cuttings, brines and paraffins, as well as industrial scale samples.

James O. Means, who has been employed as a research chemist in Tulsa for several years, has been transferred to Midland to be in charge of the new laboratory.

### *Empire Names Tulsa Representative*

Empire Machinery Company, Ltd., Odessa, Texas, has appointed E. E. Spicer to its Tulsa office. Spicer was formerly with General Motors Corporation in Tulsa and more recently with Diesel Equipment Company of Great Bend, Kansas. He sold his interest in Diesel Equipment Company and since March 1 has been with Empire. His office is at 310 Thompson Building.

The First National has grown up with the Texas oil industry. It was founded in the year, 1866, that oil was discovered in Nacogdoches County; First National customers were among the men who made oil history at Spindletop, and today's specialized banking service for oil men was developed in step with the industry's own amazing progress. At the First National, you'll talk with practical oil men who have your perspective of the industry, who understand your requirements, who follow trends and developments as closely as you do. Come in any time. You'll find First National service helpful.

FIRST NATIONAL BANK

BUILT ON SERVICE 1st SINCE 1866

in Houston

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

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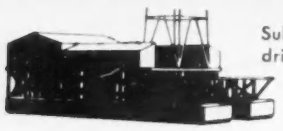
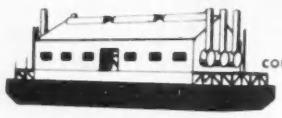
BUILDS FINE SPECIALIZED MARINE EQUIPMENT FOR THE PETROLEUM INDUSTRY



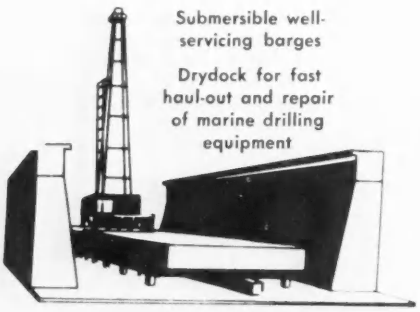
Submersible drill barges

Tugs



Boiler and compressor barges

Water, oil, and supply barges



Submersible well-servicing barges

Drydock for fast haul-out and repair of marine drilling equipment

Levingston is not only located conveniently with respect to marine drilling operations on the Gulf Coast, but here you will find marine engineers and constructors who understand the language of oil operators. Bring your marine petroleum equipment problems to Levingston *first* for a quick economical solution.

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SHIPBUILDING CO.

Orange, Texas

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

**Taking Time Out** during the annual sales meeting of the D+B Division of Emsco Derrick & Equipment Company to examine the new D+B sucker rod brochure are, left to right, F. L. Prosser, manager, Mid-Continent division; W. C. (Bill) Kinder, vice president, who presided at the meeting; J. G. Hast, plant superintendent, and G. H. Lewis, manager, Mid-Continent sales.

### *Lane-Wells Establishes Station, Moves Louisiana and Texas Offices*

Sterling, Colo., is the site of a new Lane-Wells Company truck station. James K. Wagoner, who has been with the company three years, is the operator of the new station at 631 North Third Street. With the district office at Casper and the Cody station, the addition gives Lane-Wells three points from which to serve the Rocky Mountain area.

The Arklatex district office has been moved from the Old Benton Road location to new quarters at 5000 Greenwood Road, Shreveport. At Houma, La., the sub-district office has been moved from Broad Street to the recently-built location three miles north of Houma on Raceland Highway 90. The Jacksboro truck station has been moved to Bowie, Texas, in the North Central Texas district. Warren W. Lambert is superintendent at Bowie.

Lane-Wells Company also announced that J. Murrey Walker, export sales engineer, is visiting most of the oil producing areas of South America and Mexico. Walker has been with Lane-Wells 14 years, serving in both the Operations and Sales department, and has been a representative in many areas of the U. S., Canada, and the Latin American countries.

### *Heavy-Duty Clutch Linings Added To Standco Company Products Line*

Standco Brake Line Company, Houston, is now producing and marketing a new heavy-duty clutch facing in both the gear tooth and plain disc types for use in oil production, marine, earth-moving and heavy transportation equipment industries.

### *Chief Engineer Blom Is Elected to Vice Presidency of Byron Jackson*

Carl Blom has been elected a vice president of Byron Jackson Company, Los Angeles. Joining Byron Jackson in 1924, Blom steadily advanced and became chief engineer of the Pump division in 1940.

Carl Blom

Blom was graduated in 1922 from the Trondheim Institute of Technology, Trondheim, Norway, where he specialized in hydraulic engineering. After serving one year as an instructor at Trondheim, he came to the U. S. and joined BJ as a pump design engineer.

Projects supervised by Blom include six pump units for Grand Coulee Dam, each to deliver 720,000 gallons per minute at 300 feet when driven by its 65,000 horsepower electric motor. He was also in charge of the production of 27 oil line pumps which are now moving oil 1067 miles through the Tapline

**Special Achievement Awards** were presented to three Lane-Wells Company employes whose inventions have made outstanding contributions to the company's products and services. Rodney S. Durkee, second from left, Lane-Wells president, is pictured with Irl Spangler, Arthur Zschokke and George Turechek, who were honored at a special dinner in Los Angeles.

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Managers in South and West Areas Appointed by Geophysical Service*

T. P. Ellsworth

F. E. Romberg

T. P. (Ted) Ellsworth, formerly chief geophysicist for Richfield Oil Corporation, has joined Geophysical Service, Inc., as manager of the West Coast division, George Hay Building, Bakersfield, Calif. R. C. Dunlap, Jr., vice president, transferred to the main office in Dallas.

Geophysical Service has appointed Frederick E. Romberg division manager of the Southern division, in charge of all operations in Texas, Louisiana, Arkansas and Mississippi. His office is at 1637 Esperson Building, Houston.

A graduate of the Sheffield Scientific School of Yale University in 1930, Ellsworth entered the geophysical field in 1936 with Western Geophysical Company in California. In 1943 he joined Richfield as chief geophysicist and in that capacity directed geophysical exploration in Texas, New Mexico and California, concluding with the recent campaign in the Cuyama Valley.

Romberg, a physics and mathematics graduate of the University of Texas, was employed by Humble Oil & Refining Company in 1929 as a seismograph observer and computer. In 1930 he left Humble to do graduate work at Harvard, where he received his master's degree. He joined GSI in 1933 as a computer and became a party chief in 1934. In 1939 and 1940 he worked in the Los Angeles office, developing new computational methods and equations. In 1941 he took leave of absence to work as gravity meter technician for LaCoste & Romberg in Austin, Texas.

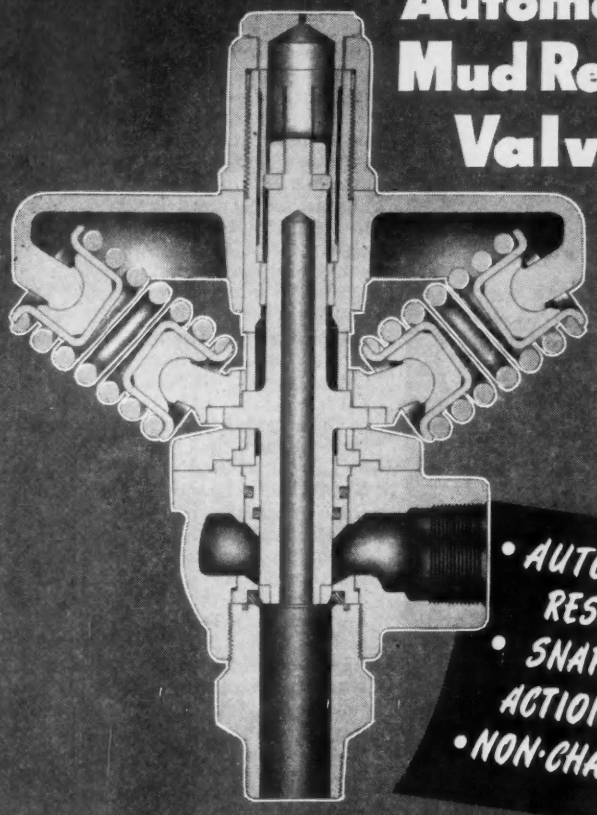
### *Five New Representatives Named To Handle BS&B Safety Heads*

Black, Sivalls & Bryson, Inc., has appointed the following as representatives for BS&B safety heads: Alabama—Equipment Service Company, Inc., 617 North 9th Street, Birmingham; Georgia—F. J. Doyle, James G. Nichols Company, 401 Georgia Savings Bank Building, Atlanta 3; North and South Carolina—W. D. Simons, Jr., Mec-Tric Control Company, P. O. Box 354, Charlotte 1, N. C.; Utah and parts of Wyoming, Idaho and Nevada—Specialty Sales Company, 208 South West Temple, Salt Lake City; parts of Tennessee, Mississippi, Arkansas and Kentucky—W. M. Ross and C. J. Gaskell, C. J. Gaskell Company, Inc., 501-502 M & M Building, Memphis.

### *Hunt Tool Buys Turney Patents*

T. N. Hunt, president of Hunt Tool Company, Houston, announced the purchase of Turney Drawworks patents. Hunt is now manufacturing the drawworks at its Houston plant as well as its regular line.


KINZBACH
Automatic Mud Relief Valve



• AUTOMATIC RESET
• SNAP ACTION
• NON-CHATTER

AT last positive automatic relief of overload pressures in mud lines is possible. The new Kinzbach Model 112 Relief Valve provides safer, more efficient pump or pressure relief and greater flexibility in operations than any other valve.

The Model 112 operates on working pressures from 750 to 2500 p.s.i. It Snaps Open for instantaneous pressure relief at maximum volume. It Snaps Shut to restore circulation instantly and automatically after a pre-determined pressure drop.

The Model 112 Valve can be used for any mud relief application, including compounding operations. Field tests prove conclusively that the Kinzbach Valve offers every operational advantage required for efficient mud operations. Write for full technical data. Ask for bulletin 11250.

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Scottie "Daring Young Man" McBlock swings through the air with the greatest of ease.

**McKISSICK SAFETY FLOOR BLOCK**

SWAYS laterally WITH EASE

. . . when used with swivel stand and patented adaptor. Sheave groove and wire line are always in conformity on wire line spools from winch drum.

All steel construction, alloy flame hardened sheaves grooved to line size.

Hi-Load roller bearings, Alemite Lubrication.

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## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Black, Sivalls & Bryson to Expand Plant Facilities at Oklahoma City*

A major expansion of its Oklahoma City plant will increase productive output 50 percent, according to an announcement by Black, Sivalls & Bryson, Inc. The Oil and Gas Equipment division, including engineering and sales staffs, is being moved to Oklahoma City, where the company's oil field equipment is fabricated and distributed. About 25 engineers and supervisors have moved from the general offices in Kansas City, to Oklahoma City.

Charles H. Meyers

Charles H. Meyers, BS&B vice president, is manager of the Oklahoma City plant.

The board of directors has authorized a $1,200,000 expansion program for both the Oklahoma City and Kansas City plants, with more than two-thirds of the expenditures going into additions to the Oklahoma City plant.

A new high bay, 80 x 600 feet, and a low bay, 40 x 440 feet, will be constructed at Oklahoma City. A total of 57,000 square feet of manufacturing area will be added. New equipment will include a 50-ton and smaller capacity overhead cranes, and a huge bending roll to roll cold steel plates up to three inches thick. Plans call for additional electrical power facilities for expanded welding procedures, a new product development and metallurgical laboratory, and relocation, redesigning and rebuilding the stress-relieving oven.

### *Southern Geophysical Company Names Personnel and Safety Supervisor*

John Hudson has been appointed personnel and safety supervisor of Southern Geophysical Company, Fort Worth. He will direct the recruiting program for the company's 14 crews in Fort Worth and Midland offices.

Educated at the University of Texas and West Texas Military Academy, Hudson has been in the oil industry for the past 20 years in the Gulf Coast, Mid-Continent, and West Coast areas of the U. S., and in Mexico. He has worked for General Petroleum Corporation, Los Angeles, Standard Oil Company (N. J.), and Texas Steel Manufacturing Company, Fort Worth.

### *Black, Sivalls & Bryson Announces Changes in Oil and Gas Division*

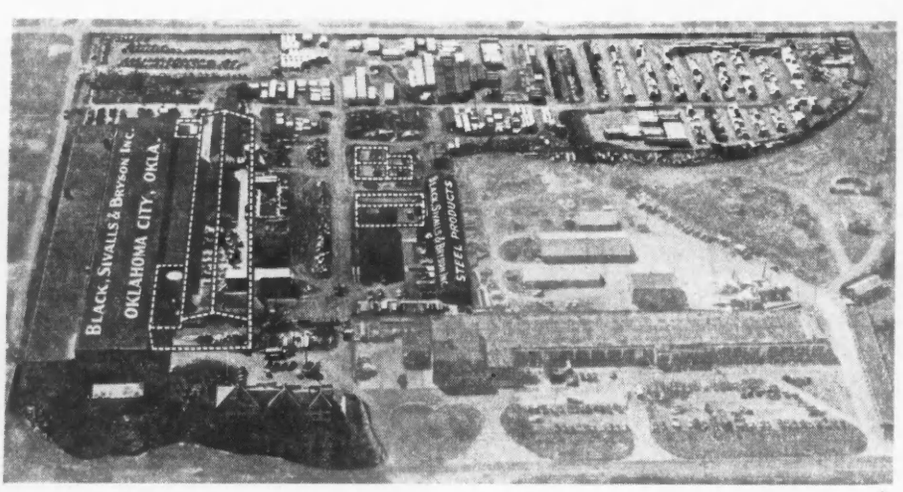
Ralph W. Nichols has rejoined Black, Sivalls & Bryson, Inc., as sales manager of its Oil and Gas Equipment division, and will have headquarters at Oklahoma City. Floyd C. Myers, manager of BS&B branch operations, has transferred his headquarters from Kansas City to Oklahoma City, in accordance with the company's policy of concentrating oil, gas and refining business at the latter point.

After graduating from Kansas University in 1926 with degrees in engineering, Nichols served as chief engineer with the Wooded Hills Development Company for two years, and as chief engineer with the Darby Corporation for three years. He then joined BS&B serving successively as estimator, draftsman, engineer, project engineer, contact man and manager of the Fort Worth sales office. From 1945 to near the close of 1950 he was sales manager for the Richmond Engineering Company.

Ralph W. Nichols

Floyd C. Myers

Myers started with BS&B in 1929 as a clerk in the Tulsa office. He was later transferred to sales and service work in Texas, becoming a branch manager in 1935. Five years later he was made assistant credit manager, assuming the duties of credit manager during the war period. Following that, he returned to the branches and became district sales manager for West Texas in 1946.




**Black, Sivalls & Bryson's 24-acre Oklahoma City plant is pictured, with dotted lines indicating the new plant and warehouse construction. Center foreground is the three-unit office building.**

## EQUIPMENT and SERVICE SUPPLIERS' NOTES

### *Two Top Executives are Elected By American Hoist and Derrick*

R. J. Stoddard

J. F. Bishop

Robert J. Stoddard has been elected vice president of engineering and James F. Bishop, secretary-treasurer, was elected a director of American Hoist and Derrick Company.

Stoddard, a graduate of the University of South Carolina with a C.E. degree and of M.I.T. with an M.S., started his business career with American Bridge Company. He also worked for Tennessee Valley Authority before joining American Hoist in 1937 as assistant chief engineer. He is also a director.

Bishop began in American Hoist's Accounting department in 1923 as a general clerk and office boy, and later rose to the position of manager of the Order department. He has been secretary-treasurer since 1945.

### *Texas Electric Steel Casting Head Honored by Steel Founders' Group*

Thomas H. Shartle, president of Texas Electric Steel Casting Company, Houston, was the winner of the top award of the Steel Founders' Society of America, the Lorenz Memorial Gold Medal for distinguished service to the steel casting industry. He was also re-elected to his third consecutive term as president and chairman of the executive committee. Shartle was chosen as the recipient by a ballot vote of the membership.

Thomas H. Shartle

### *Brown Is Appointed Sales Engineer In Pacific Pumps' Los Angeles Area*

W. E. Brown has been appointed sales engineer for the Los Angeles district of Pacific Pumps, Inc. He succeeds J. W. McCormick, transferred to New York.

Brown was graduated from Iowa State College at Ames, Iowa, in 1941 as mechanical engineer.

### *Wilson Moves Two Representatives*

Wilson Manufacturing Company, Wichita Falls, Texas, has transferred two representatives of the Sales and Service department. Ed W. Smithson has moved from Great Bend, Kansas, to Carmi, Ill., and Louis A. Gosden, who formerly was in charge of sales and service at Carmi, has been moved to Edmonton, Alberta.


## Here's what oil men are saying about World Oil

**Superintendent** — *"Before I bring this letter to a close, I must tell you how highly we think of* World Oil *out here. Every issue brings very interesting articles with information that is most valuable."*

**Toolpusher** — *"Thanks for the many helpful 'how-to-do-it' hints received from* World Oil *each month."*

**Engineer** — *"I do not want to miss any issues of* World Oil *as I find your publication very useful in my work."*

**Shop Foreman** — *"I have a great deal of respect for the articles appearing in* World Oil *and you have a fine following of advertising that enables one to keep abreast of the latest modifications in equipment."*

**Geologist** — *"To my complete satisfaction, monthly issues of* World Oil *are coming in on schedule. We find your magazine of extreme interest and of estimable value."*

**Oil Executive** — *"We are moving our offices in the very near future and we do not want to miss out on any numbers of your fine publication* World Oil."

The magazine that's specialized for exploration, drilling, producing and pipeline operations and management. Considered as useful as any tool in the oil field by the thousands of oil men who read WORLD OIL regularly.

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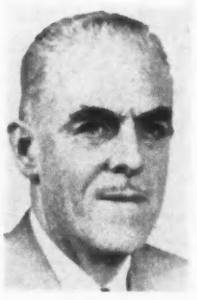
☐ Drilling ☐ Pipe Line ☐ Supply ☐ _____
☐ Remittance enclosed ☐ Bill me later E1

### *Rockwell Meter and Valve Division Shifts Four in Sales Organization*

Meter and Valve division, Rockwell Manufacturing Company, has announced several personnel changes in the company's sales force.

E. E. Matheson has moved to the Oakland, Calif., plant. Prior to 1928, he was an engineer with Shell Oil Company and later chief engineer of the Victory Manufacturing Company. He joined the Nordstrom Valve division as a sales engineer and later became branch manager for the northern California territory. In 1945 he was appointed general sales manager. In his new capacity Matheson will headquarter at Rockwell's Nordstrom Valve plant in Oakland.

H. Gottwald will become general sales manager for Nordstrom valves. He started with the organization in 1928 as a sales engineer in the New York district office He was later appointed assistant vice president of the Rockwell International Corporation, handling all Rockwell products throughout the Western Hemisphere. Since his move to the home office he has been successively assistant sales manager of Nordstrom valves and assistant vice president of the company's Meter and Valve division.



E. E. Matheson

H. Gottwald

R. R. Bush

O. W. Barnett

R. R. Bush will be oil field products sales manager. He was employed by the Texas Pipe Line Company before joining Rockwell in 1934 as a sales engineer for the Tulsa district. Shortly before assuming his new responsibilities he was named special representative for Nordstrom valves.

O. W. Barnett will be sales manager of warehouse and jobber sales. He joined the company in 1934 and was assigned to field work in Oklahoma and Louisiana. In 1950 he was appointed gas products sales supervisor in the Tulsa area and later became assistant sales manager for the Nordstrom division.

### *Cleco Moves Philadelphia Division Office; Names New Distributor*

Cleco Division of Reed Roller Bit Company, Houston, has moved its Philadelphia office to 5200 North Fifth Street, Philadelphia 20.

Gil Boers Equipment Company, 7625 South Kedaic Avenue, Chicago, and Airline Equipment Company, 2024 Frankford Avenue, Philadelphia, have been appointed distributors for Cleco products.

### *Canadian Firm Handles Widco Logger*

Well Instrument Developing Company, Houston, has appointed Southwestern Industrial Electronics Company, 434 7th Avenue E., Calgary, Alberta, Canada, as its representative in Canada. SIE will handle the sales and repair service of Widco electric loggers. The Canadian Branch of SIE is headed by Emmet House.

## WORLD OIL'S Trading Post

CLASSIFIED ADS — SERVICES PERSONNEL USED EQUIPMENT

**RATES:** Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

#### SITUATION WANTED

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.

■ CIVIL Engineer-Constructor. 38 years in Latin American Tropics. Non-graduate. Responsible charge of exploration, topographical and boundary surveys, heavy and light building and oil field construction, location and construction of railways and roads. Pensioned by major oil company after thirteen years service. Box 15-W, c/o World Oil, Houston, Texas.

■ SEISMOLOGIST, familiar with West, East and North Texas, also Gulf Coast and California offshore operations. Drilling and Production experience. Personnel Experience. Degree in Petroleum Engineering. Desires position with either major oil company or independent. Thirty day availability. Box 16-W, c/o World Oil, Houston, Texas.

#### FOR SALE

■ Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.

#### WANTED TO BUY

■ WANTED: 7" oil well casing, new or excellent used, about 3000 feet. Also need used rotary mast and substructure. Box 17-W, c/o World Oil, Houston, Texas.

■ WE WILL BUY Producing Oil Royalties. Send Particulars. Standard Security Co., 115 Broadway, New York 6, New York.

■ INDIVIDUAL will purchase producing royalties, oil or gas. James R. Curtis, Longview, Texas.

#### INVESTMENT OPPORTUNITY

■ Well established British Oil Equipment and Supply Company with Head Office in London is interested in acting as European and Sterling Area sales representatives for all classes of equipment and supplies connected with the Oil and Mining Industries. Please communicate with Box 12-W, World Oil, Houston, Texas.

#### FOR SALE

■ FOR SALE: Used Askania Magnetometers. Magnetometer Repair Department. Robertson Instrument Company, 5022 Ennis Street, Houston, Texas, JA-5813.

■ SLIGHTLY USED Drill Pipe—2—3/8 O.D.—1800 feet. This pipe is like new—for full particulars, contact Bradford Supply Company, Owensboro, Kentucky.

■ FOR SALE: A small lease close to production in good Louisiana gas distillate field. Lots of activity. Owner, Box 33, Arcadia, Louisiana.


# FOR SALE

## MODERN OFFICE AND WAREHOUSE BUILDING IN HOUSTON, TEXAS

**Located in Heart of Best Commercial and Industrial Area—on Navigation Boulevard. Suitable for Manufacturing, Warehousing or Fabrication.**

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# New Books, Maps and Movies

## Facts and Figures

The ninth edition of "Petroleum Facts and Figures" contains 468 pages, more than twice the number available in the 1947 book, the last issue. Charts, graphs and other illustrations were held to a minimum in the new edition to provide maximum leeway for new tables and additional statistics. The new edition stresses long-term series of comparable tables wherever possible on utilization, production, refining, marketing, transportation, prices and taxation. Tables have been added on business, operating and allied statistics.

Statistics for the tables were collected and compiled by the Research Section of the API Department of Information, with the assistance of other API divisions, government agencies, oil company authorities, and independent oil experts.

Department of Information, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y. $2.50.

## French Oil Industry

"Guide du Petrole," a yearbook of the French oil industry, contains listings of company officers, engineers, material and equipment suppliers, refiners, producers, and transportation firms—both foreign and domestic—connected with the petroleum industry in France. In addition to the directory sections, the 18th edition contains a large division devoted to government regulations concerning the industry. Complete texts of French laws governing exploration, production, refining and marketing are given. Tabular statistics and discussions of production in French possessions and other areas are included.

O. Lesourd, 252 Faubourg Saint-Honore, Paris (8), France.

## Exploration and Development

First published in 1925, "Oil Field Exploration and Development" has been brought up-to-date in the new edition by the addition of appendices. A. Beeby Thompson, the author, emphasizes in the new issue techniques and equipment developed since 1924, maintaining that principles involved in exploration and exploitation are essentially the same as they were in that early period in the history of the oil industry.

In addition to an extensive discussion of oil fields from the geologist's viewpoint, the two-volume set contains sections on drilling techniques, secondary recovery, and refining operations. Pull-out maps show the geographical distribution of the world's oil and gas reserves, and the text gives brief data on special techniques used in the various fields.

Material contained in the first part of the book, which is largely reprinted from the 1925 version, covers theories on the origin of oil, classification and mapping of structures, and other principles concerned with exploration.

Anglobooks, 475 Fifth Avenue, New York 17. $20.

## Corrosion Literature

Abstracts of corrosion literature published during 1946 and 1947 have been published in book form. There are more than 3000 abstracts arranged topically according to the NACE Abstract Filing Index and cross-referenced.

National Association of Corrosion Engineers, 919 Milam Building, Houston 2. $9 ($7 to members).

## Petroleum Prospects

"Possible Future Petroleum Provinces of North America," a new AAPG book, presents an up-to-date picture of undiscovered resources. It is a symposium representing the work of 17 geological societies, 13 federal, state and provincial geological surveys, or analogous organizations, representatives of 33 or more oil companies and eight universities, and 24 consulting geologists. There are 153 line drawings in the 360-page volume, which was edited by Max W. Ball, Arthur A. Baker, George V. Cohee, Paul B. Whitney and Douglas Ball.

The American Association of Petroleum Geologists, P. O. Box 979, Tulsa 1. $4 postpaid ($2.50 to members).

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The tougher the job you assign them to, the quicker you'll recognize the fact that every Aetna bearing is engineered to give it extra stamina in every part.
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## Modernize Your Well Servicing Units

If you want your well servicing units to be fully equipped for safe, fast operation, be sure they are equipped with O'BANNON AUTOMATIC TUBING SPIDERS.

This spider permits the crew to stand clear of the well head while slips are being engaged or released and enables the men to turn out more work in less time—in safety.

- **AUTOMATIC**
- **SAFE**
- **ECONOMICAL**

While tubing is in motion, slips are suspended away from the tubing. Coming out of the hole, a direct acting jaw rides the tubing constantly, and any downward motion of the tubing sets the slips. Going in, the jaw is engaged by simply releasing a small rope held by one of the crew.

The spider will handle 2", 2½" or 3" tubing, each size of tubing requiring slips and guide ring to correspond. A complete spider includes slips and guide ring for one size of tubing, and changing to slips and guide ring of another size is easy and quick.

*Bring your pulling units up to date by equipping them with these spiders.*

***Sold By Supply Stores***

**Walter O'Bannon Co.**

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### Marvel

A man was discovered by his wife one night standing over his baby's crib. Silently she watched him. As he stood looking down at the sleeping infant, she saw in his face a mixture of emotions—rapture, doubt, admiration, despair, ecstasy, incredulity. Touched and wondering alike at this unusual parental attitude, the wife with eyes glistening arose and slipped her arms around him.

"A penny for your thoughts," she said in a tremulous voice. He blurted them out:

"For the life of me, I can't see how anybody can make a crib like that for $3.49!"

### A Bang-Up Time

Policeman: "No license, Miss? You know, you can't drive without one."

Miss: "That explains everything. I thought it was because I was nervous and near-sighted that I bumped two cars and ran into this hydrant."

### Abridged Version

Shocked by the language used by two workmen repairing telegraph wires close to her home, a spinster reported the matter to the company. The foreman in making his report on the incident wrote:

**"Mighty thorough—those boys from that aerial geophysical survey outfit!"**

"Me and Bill was on the job. I was up the pole and let some hot lead fall and it went down Bill's neck. He said, 'You really must be more careful, Harry,' and I said, 'Indeed I must, Bill. I will see that it don't happen again.'"


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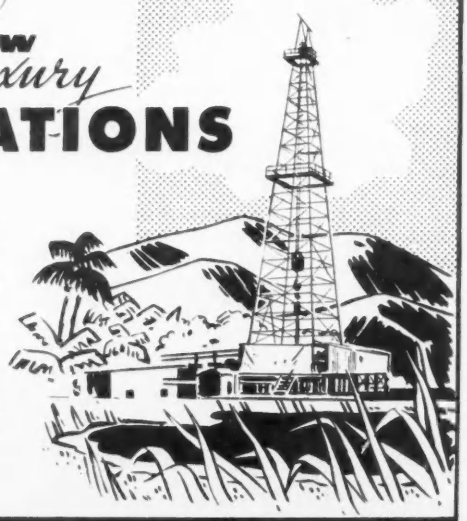

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# What's NEW

In Perforating, Testing, and Fishing Tool Services

McCULLOUGH®
NEW SERVICES • NEW TOOLS
NEW WAYS OF DOING THINGS

*Latest News About New Tools, Techniques and Services*

## The McCullough MAGNA-TECTOR

# KEY PROGRESSIVE TOOL

### Quickly Tells Exactly WHERE Pipe is Stuck, Eliminates or Simplifies Fishing, Saves Time, Money, and Pipe

**A PROGRESSIVE TOOL** is a tool that permits a FAST return to normal PROGRESS in an oil well. Included in the 20 McCullough services are 6 progressive tools. The KEY tool in this group is the Magna-Tector. It is called the KEY tool because it unlocks the secret of exactly WHERE pipe is stuck, and opens the way for other progressive tools to complete the job in minutes.

**Save Pipe, Time, and Money—
Call for the Magna-Tector FIRST!**

When casing, tubing, or drill pipe becomes stuck, considerable savings can be realized by calling for the Magna-Tector at once. This has been proven in thousands of wells. Estimating the stuck point, cutting the pipe, and then finding that the estimate was wrong is a costly method. Unnecessary cuts must be paid for, rig time is multiplied, and fishing usually becomes complicated.

By calling for the Magna-Tector at once, the danger of pipe sticking further up the hole is minimized. The exact stuck point is located within inches, in minutes. The number of shots or cuts required to recover all free pipe is reduced. More free pipe is recovered in ONE piece. The way is paved for other fast, McCullough electric wire line progressive tools (McCullough Jet Back-Off Tool, String Shot, or Jet Casing Cutter) to free all free pipe, making recovery of the remaining stuck sections routine.

Drill pipe is the most common stuck pipe condition. When drill pipe becomes stuck, it is usually assumed that the drill collars are stuck. Spotting oil around the drill collars, without first calling for the Magna-Tector, has proven to be false economy. In many instances, after oil had been spotted around the drill collars without results, the Magna-Tector was called upon. The stuck point was found to be several hundred feet above the drill collars. When the oil was moved up to the EXACT stuck point, the pipe was freed in only a few hours time. MORAL: Guesswork is a poor substitute for KNOWING, always use the Magna-Tector FIRST!

**Not a Fishing Tool**

The Magna-Tector is NOT a fishing tool. Fishing means probing with unseeing eyes. The Magna-Tector has eyes at the surface. These eyes, in the form of electronic meters, tell the McCullough serviceman what he needs to know about the condition of the pipe in the well. In some cases the Magna-Tector eliminates the need of fishing tools. In other cases it simplifies recovery by reducing the number of shots or cuts usually needed.

**How the Magna-Tector
Locates the Stuck Point**

The Magna-Tector is an electronic tool. It is unaffected by high hydrostatic pressure or high temperature. It has been successful on over 5,000 jobs. In the world's deepest well, the Magna-Tector located the stuck point in the drill pipe below 16,000 feet!

In operation, the Magna-Tector is lowered inside of the stuck drill pipe, casing, tubing, or liner on an electric wire line. It is positioned at a pre-determined depth for testing. Electric current is then turned on, energizing two electro-magnets at each end of the tool. This strong magnetic force holds the Magna-Tector, firmly, against the pipe. Tension is applied to the pipe at the surface. Any movement of the pipe between the two electro-magnets, as detected by electronic surface meters, indicates free pipe. Lack of movement indicates stuck pipe. By progressing up or down, the EXACT stuck point can be located within inches!

**An Additional Service—
Determining the Sticking Medium**

The value of the Magna-Tector is twofold. In many cases it can actually determine the sticking medium. It can indicate such conditions as: collapsed pipe; frictionally held pipe; bridging; and key seat conditions. In tubing it can determine whether the tubing is stuck above or below a packer or tubing hanger. With such additional knowledge, freeing and recovery of all pipe is greatly simplified.

Where drill pipe is frictionally held by mud, sand, or other impacted material, working and circulation sometimes results in freeing the pipe deeper in the well. In one outstanding instance, where this procedure was used, the pipe was freed 1,800 feet BELOW the original sticking point!

**Combination Progressive Service—
Another Way to Save Time**

The set-up used by the Magna-Tector is the same set-up as used by any McCullough electric wire line progressive tool. Since the set-up at the well is already made, it's a simple matter to attach a McCullough Jet Back-Off Tool, String Shot, or Jet Casing Cutter to the end of the same electric wire line, after the Magna-Tector has located the stuck point. Therefore, many operators, when ordering Magna-Tector service, also order the type of progressive tool they will need to complete the job. Rig time is saved and combination service charges apply, resulting in additional savings.

**Write for this Catalog**

The new McCullough section of the Composite Catalog is now off the press. All 20 McCullough tools and services are included in this catalog. Illustrations, operating data, construction, and specifications. Pages 3228 and 3229 describe the Magna-Tector and its applications, with appropriate photographs and illustrations. Write to the McCullough Tool Company for your copy.

**PERFORATING, TESTING AND FISHING SERVICE ANYWHERE — ANYTIME!**

**McCULLOUGH TOOL COMPANY**

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**VENEZUELA:** United Oilwell Service Co., S.A.; Caracas, Anaco, Maracaibo

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Mid-Continent NEWS and HUMOR?

**We're Jumping With Joy Too . . .**

. . . because it's Spring again, and with the advent of Spring our NEWS sheds its winter coat, puts on its T-shirt and shorts and goes out to commune with nature.

The articles and stories sprout that fresh, new look . . . our "Teasecake" girls begin to think of running mountain streams, the beach and hikes into the woods . . . our humor will pitter-patter around giggle boxes like rain spanking down on a tin roof . . .
So starts a new season for the Mid-Continent NEWS!

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## SQUEAKS FROM THE BULLWHEEL

### Revenge

Tired of having the cigars in his vest pocket broken each day by a boisterous fellow worker, Jim showed up at the office one day with what appeared to be several oversized cigars in his pocket.

When asked what they were, he confided: "They're really not cigars at all but sticks of dynamite. When Johnson thumps me on the chest today he'll blow his hand off!"

### No Help Needed

The doctor's waiting room was full. Every chair was taken; some patients were even standing. There was a desultory conversation, but after a while silence fell. The patients waited. Finally, an old man stood up wearily and remarked, "Well, I guess I'll go home and die a natural death."

### Self-Defense

A henpecked husband was being examined in the witness chair during a court trial. "Do you mean to tell me that you have always treated your wife with the greatest respect?" asked the bullying examiner.

"Always," replied the husband firmly.

"And you've never once spoken a harsh word to her?"

The man in the witness chair hesitated for a moment and the attorney was quick to seize his opportunity.

"Be careful how you answer," he roared.

"Well," said the henpecked husband at last, "I remember I did yell at her once to 'Put down that poker!' "

### Double-Entry Man

Census taker: "Do you live within your income?"

Jed: "Good heavens, no. It's all I can do to live within my credit."

### Calculating

Some girls count on their fingers, but a smart girl counts on her legs.

"The last time I danced for an oil men's stag party, they paid me in royalty—under a well that had been dry for 20 years. No sir! Cash this time!"

### How Does Your Garden Grow?

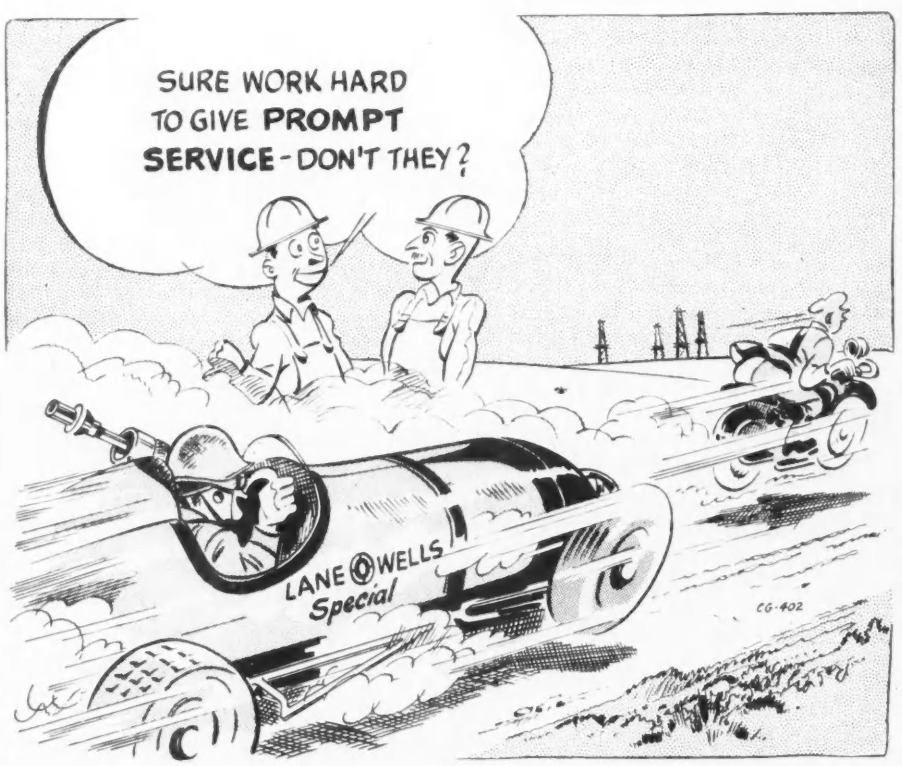
"Dad, do they raise political plums from seed?"

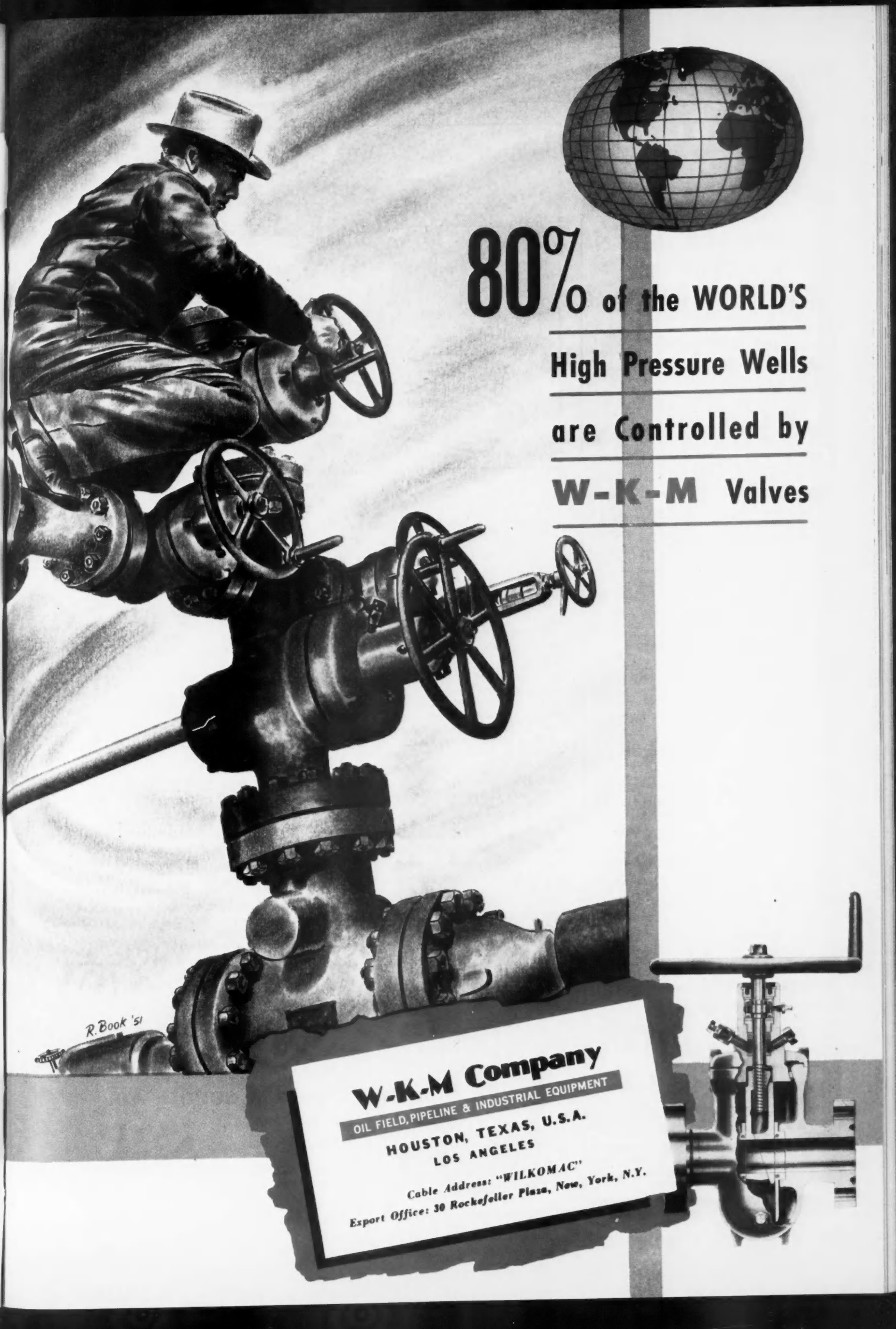
"No, my boy, political plums are more often the result of a bit of clever grafting."

### Profession

"Mama, what's a second-story man?"

"Your father is one, dear. If I don't believe his first story he always has another one ready."

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HOUSTON, TEXAS, U.S.A.
LOS ANGELES
Cable Address: "WILKOMAC"
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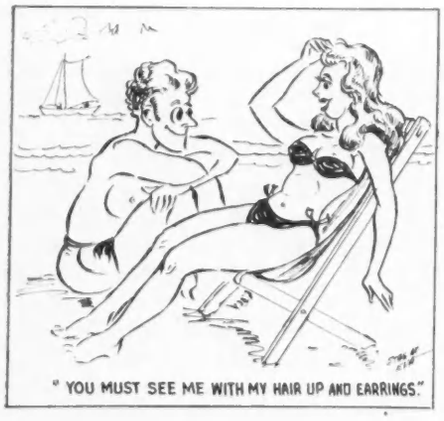
# Mid-Continent NEWS and HUMOR?

## We're Jumping With Joy Too . . .

. . . because it's Spring again, and with the advent of Spring our NEWS sheds its winter coat, puts on its T-shirt and shorts and goes out to commune with nature.

The articles and stories sprout that fresh, new look . . . our "Teasecake" girls begin to think of running mountain streams, the beach and hikes into the woods . . . our humor will pitter-patter around giggle boxes like rain spanking down on a tin roof . . .

So starts a new season for the Mid-Continent NEWS!



"YOU MUST SEE ME WITH MY HAIR UP AND EARRINGS."

MID-CONTINENT Supply Company

General Offices Mid-Continent Bldg. FORT WORTH, TEXAS


## SQUEAKS FROM THE BULLWHEEL

### Revenge

Tired of having the cigars in his vest pocket broken each day by a boisterous fellow worker, Jim showed up at the office one day with what appeared to be several oversized cigars in his pocket.

When asked what they were, he confided: "They're really not cigars at all but sticks of dynamite. When Johnson thumps me on the chest today he'll blow his hand off!"

### No Help Needed

The doctor's waiting room was full. Every chair was taken; some patients were even standing. There was a desultory conversation, but after a while silence fell. The patients waited. Finally, an old man stood up wearily and remarked, "Well, I guess I'll go home and die a natural death."

### Self-Defense

A henpecked husband was being examined in the witness chair during a court trial. "Do you mean to tell me that you have always treated your wife with the greatest respect?" asked the bullying examiner.

"Always," replied the husband firmly.

"And you've never once spoken a harsh word to her?"

The man in the witness chair hesitated for a moment and the attorney was quick to seize his opportunity.

"Be careful how you answer," he roared.

"Well," said the henpecked husband at last, "I remember I did yell at her once to 'Put down that poker!' "

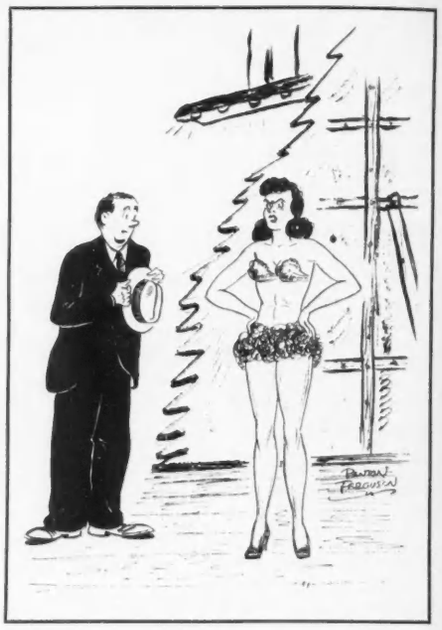
### Double-Entry Man

Census taker: "Do you live within your income?"

Jed: "Good heavens, no. It's all I can do to live within my credit."

### Calculating

Some girls count on their fingers, but a smart girl counts on her legs.



"The last time I danced for an oil men's stag party, they paid me in royalty—under a well that had been dry for 20 years. No sir! Cash this time!"

### How Does Your Garden Grow?

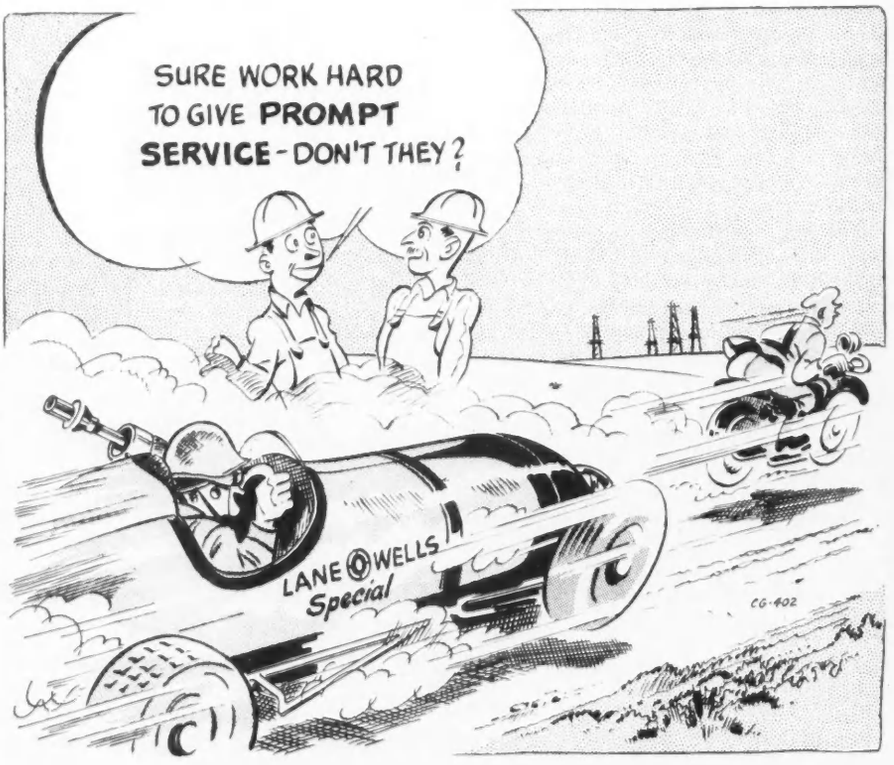
"Dad, do they raise political plums from seed?"

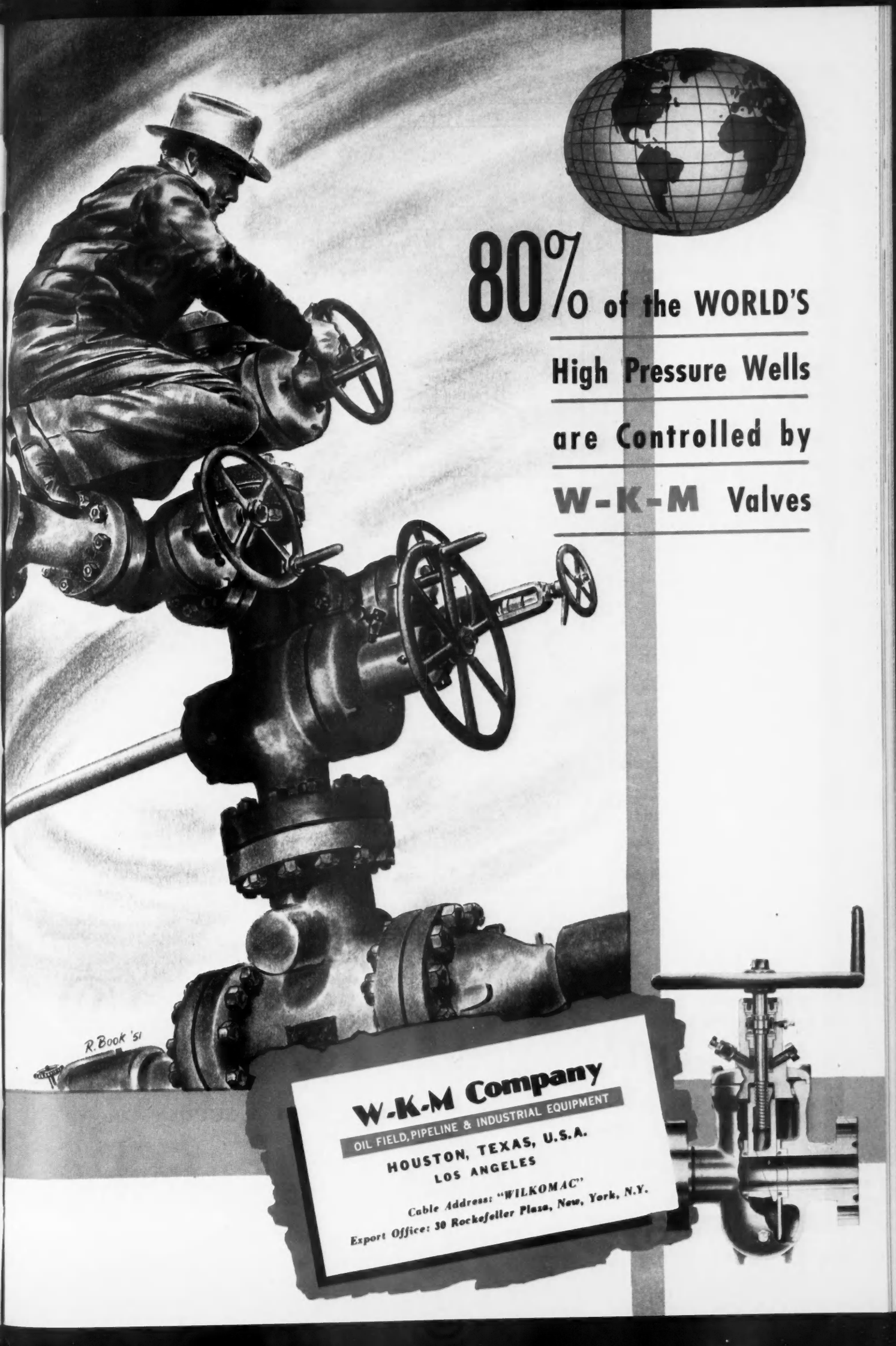
"No, my boy, political plums are more often the result of a bit of clever grafting."

### Profession

"Mama, what's a second-story man?"

"Your father is one, dear. If I don't believe his first story he always has another one ready."

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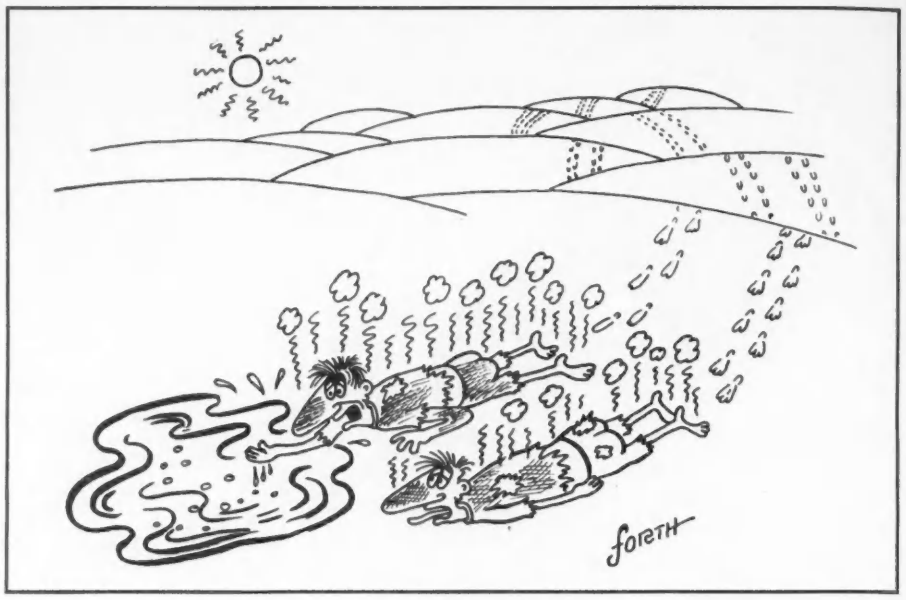
## SQUEAKS FROM THE BULLWHEEL




"Dammit—nothing but oil!"

### Simple Precaution

Driving in the business section of a city, a man tried to edge his car past one driven by a woman, who was trying to park in close quarters. Suddenly the woman's car crashed into his.

Flushed with exasperation, she leaned her head out the car window. "You could see I was going to do something stupid," she said, "why didn't you wait to see what it was?"

### At the Pearly Gates

A traveling man stopped at a small town garage and told the mechanic, "Whenever I hit 70, there's a knocking in the engine."

After a lengthy examination and much testing, the mechanic wiped the grease from his hands and drawled, "I don't see nothing wrong, mister. It must be the Good Lord warning you!"

### Trumped

In order to while away the time, an expectant mother was spending the evening playing bridge. She was dealt a strong hand and bid a grand slam. Before she could make her first lead, she was rushed to the hospital. When she gained consciousness she gave the doctor an inquiring look and asked: "Did I make it?"

"You sure did," replied the doctor, "with two fine sons!"

"Oh," she groaned, "I knew I was vulnerable but I didn't know anyone doubled me."

### Knock, Knock

An opportunist is a woman who finds the wolf at the door and appears later in a new fur coat.

### Ladies' Aid

"Why," asked the Sunday School teacher, "was Solomon the wisest man in the world?"

A bright-faced little girl raised her hand. "I know, teacher," she volunteered. "He had so many wives to advise him."

### Side-Drape

"But, my dear," said the artist to his model, "that isn't the place for your fig leaf. It's too high and too far to the right."

"Oh," she apologized, "I thought you wanted it to cover the scar from my appendicitis operation."

### Diagnosis

Psychiatrist to sad-eyed patient: "My dear fellow, you have no complex. You are inferior."